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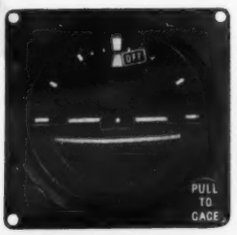

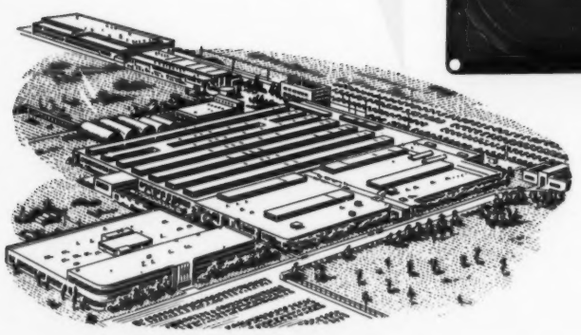

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Two North American B-45 "Tornado" jet bombers.

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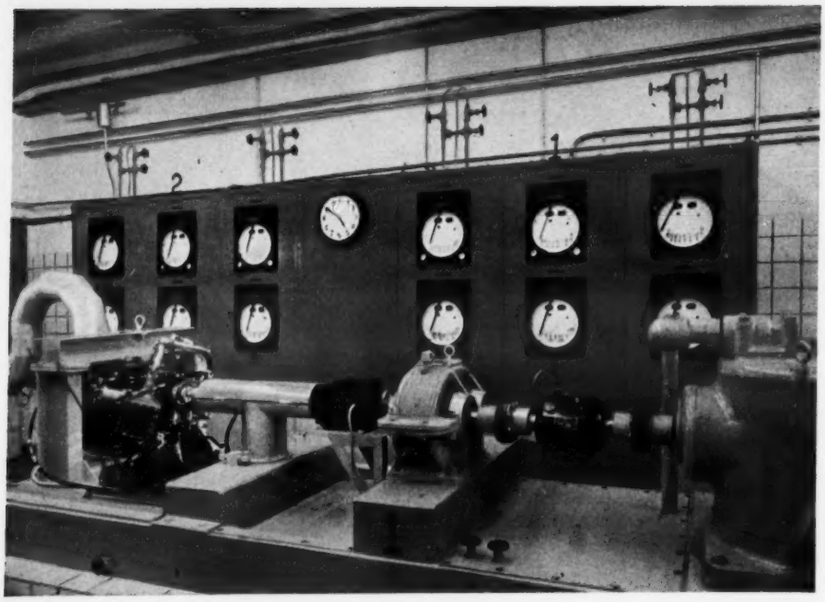

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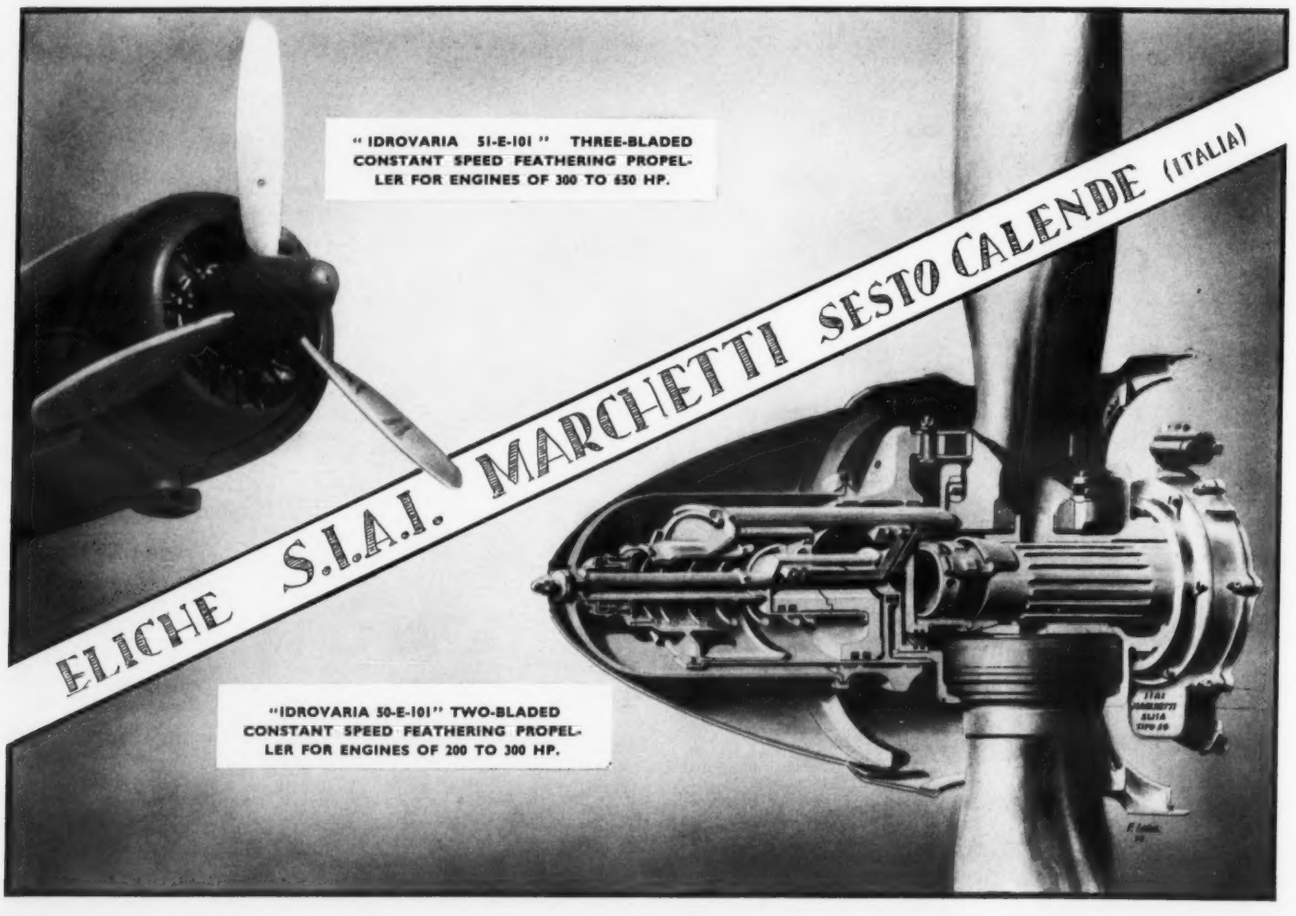
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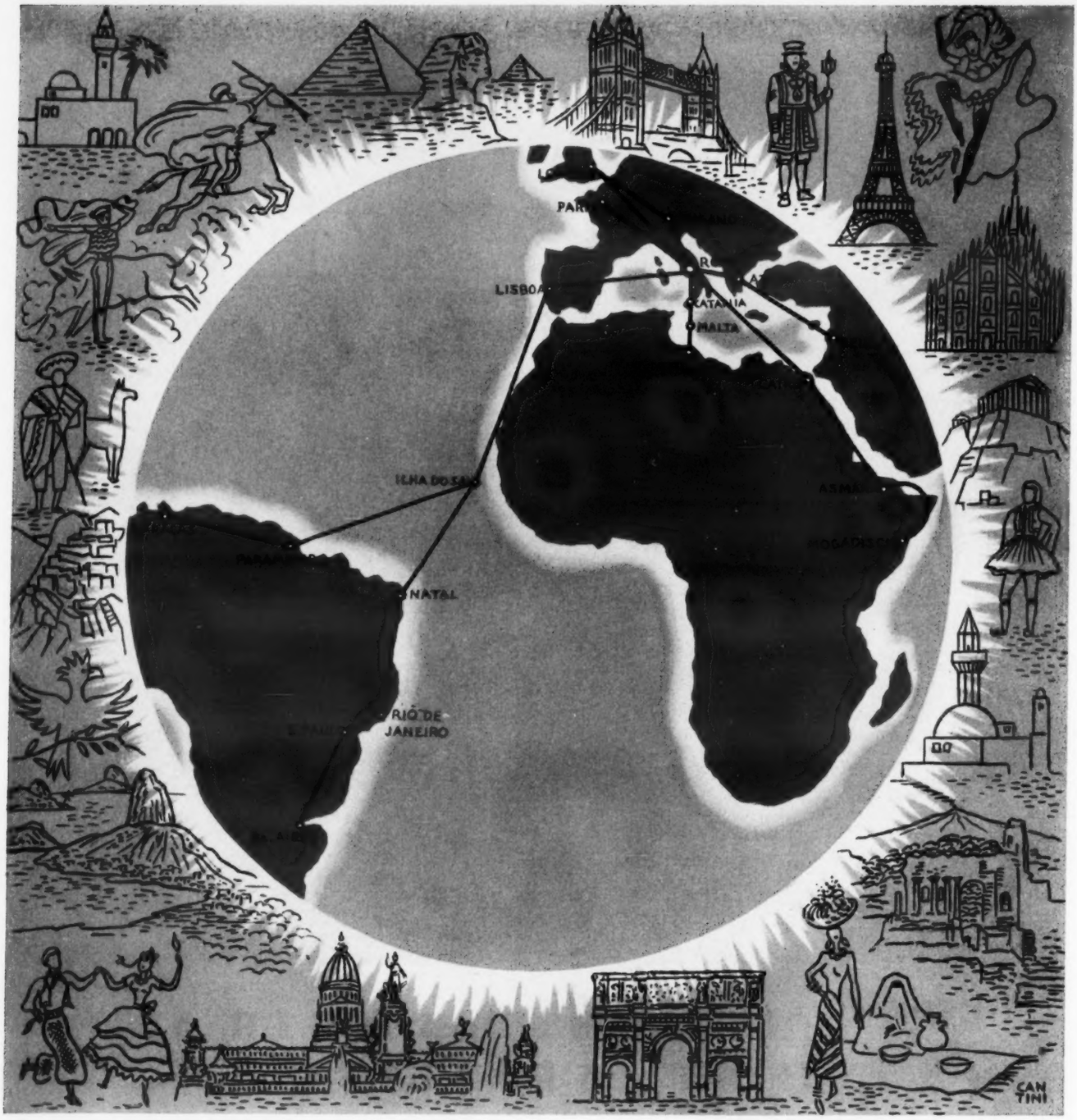

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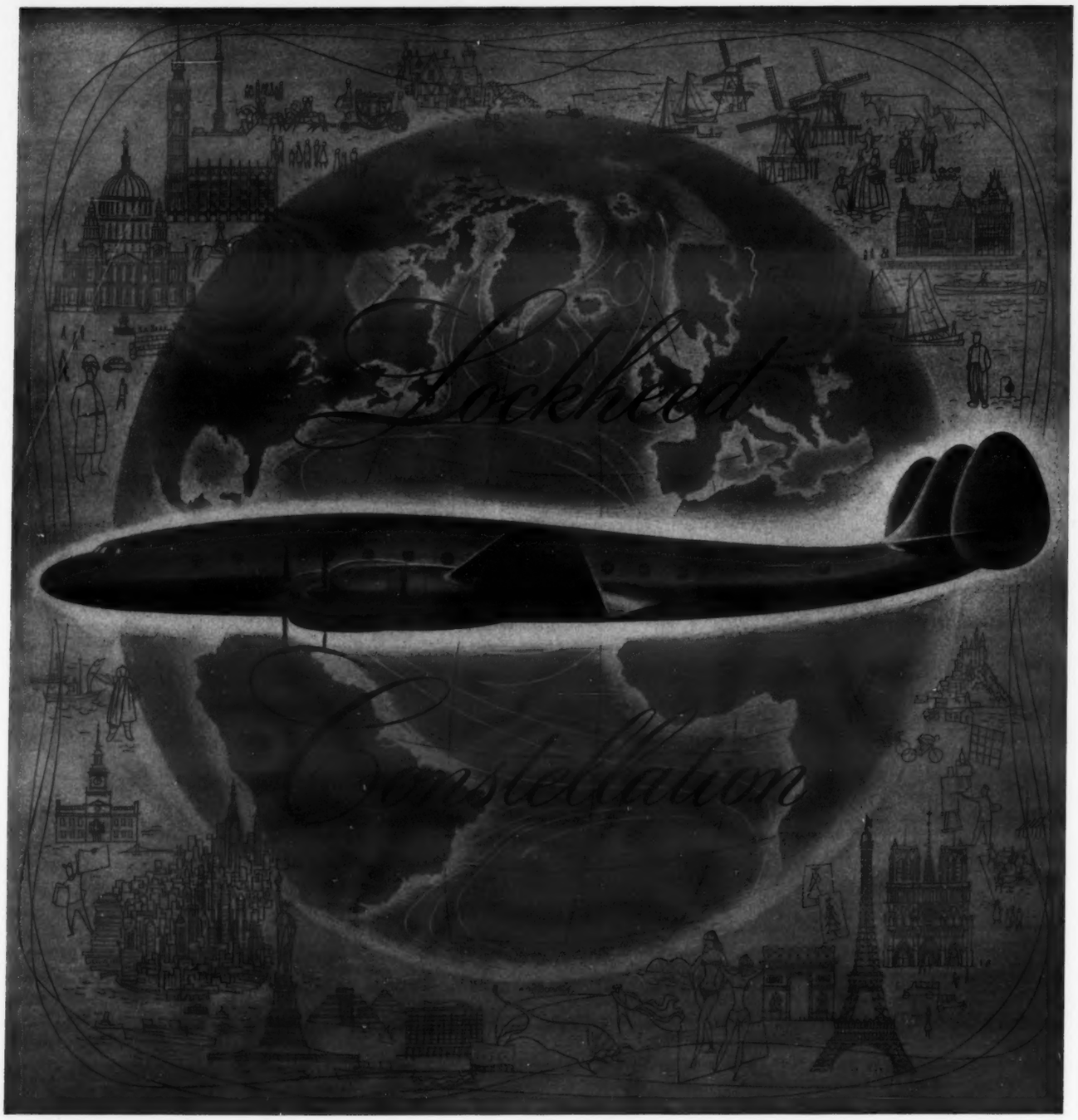

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A long-departed poet, famous in his day, compared life to a switch-back. To us it seems more like a merry-go-round.

One day in 1937, at the League of Nations headquarters in Geneva, the Chinese delegate was approached by a colleague who, with worried expression came to condole with him on the events of the Sino-Japanese war.—"A Sino-Japanese war ?" replied the son of Heaven unperturbed. "... Our history is so many thousands of years old, in another thousand this incident too will be forgotten."

Who remembers the Sino-Japanese war today ? And who will talk about the Korean conflict tomorrow ?—Let us regard the world with a little more serenity and calm, if possible with a little more wisdom.

We have survived the first half of the Twentieth Century. Perhaps having passed through the valley of the shadow we shall soon emerge into the light.

Sustained by this hope we shall find the music of today's merry-go-round less strident.

We wish all our readers a Merry Christmas and a Peaceful and Happy New Year.

INTERAVIA

The Defence of Western Europe

For many months past the burning topic in parliamentary debates, Foreign Ministers' conferences, defence talks, General Staff meetings, daily newspapers has been the same ; strategic planning and the defence of Western Europe. Not only is there a yawning abyss between East and West, but even in the West there is by no means unanimity on defence matters.

What is to be defended is clear to most. But *where* and *how* are different questions. Here the opinions of the experts differ extensively.

Interavia could not let the first half of the twentieth century draw to a close without attempting to throw some light on at least part of this overall problem, i.e. on the question of air strength. We have therefore called upon a Frenchman, a Briton and a German to give us their views.

The Frenchman, *Lieutenant-Colonel Pierre M. Gallois,* is well-known as a military commentator and one of the leading contributors to the official French monthly journal "Forces Aériennes Françaises." What he has to say on the subject of European air strength today may well make interesting reading, even for members of the "Combined General Staff" of the Atlantic Powers. The layman will probably lose some of his over-optimism.

The Briton, *Captain Norman Macmillan,* is a practical authority on aeronautical and naval problems. It seemed to us that an Englishman would be most fitted to discuss a domain in which Great Britain has played so outstanding a part for so long.

As for the German, we have chosen a man whose experience has not been confined to the *military* field. *Dr. Robert Knauss,* ex-General of the Luftwaffe, expert on constitutional law, played a prominent part in civil aviation in Germany before the war. During World War II he was Commandant of the German Air Staff College, but was later removed by Hitler because of his "unreliability." He discusses the question of whether German participation in the defence of Europe can be permitted and how such participation could be brought about.

Another article investigates the cost of the present armed peace to the taxpayer of the West, and finally one of our special correspondents describes by means of a practical example the first steps of Western air forces towards co-operation.

Is Western Air Power Adequate?

BY PIERRE M. GALLOIS

It is easy enough to recognise that the world today is gradually becoming more and more obsessed by the fear of war. But is it equally clear that either of the two opposing camps really have the means to launch and sustain a global conflict? True, the USAF could deal a crippling blow at the vital sources of an adversary's power. But it is well-known that America will never take the initiative and that her Strategic Air Command is a weapon of reprisal, not an instrument of aggression. On the other side, Russia and her satellites may well possess atomic weapons, but it is doubtful whether they are in a position to drop them in the heart of the New World. No Russian reply to the B-36 yet appears to be in existence and the day of the long-range unmanned atomic missile is not yet.

The inadequacy of other air weapons is also apparent, though to a lesser degree. Admittedly the USSR has powerful tactical air forces, built up not only on experience gained during World War II but also on the technical advances of the past five years, so that they now form a thoroughly modern arm. However it is unlikely that these forces could be deployed and, more important, could set in motion the huge potential they represent, at the very onset of hostilities, i.e. before atom bomb reprisals could be taken. Moreover, present-day air strategy is universally based on the use of new methods of propulsion, in spite of the fact that experience of these methods during the last war is distinctly meagre.

On this side of the Iron Curtain ground support air forces are virtually non-existent. There are some who regard this military weakness as an invitation to aggression and urge that the—temporary— supremacy of the *Strategic Air Command* be used to establish that parity of the more conventional weapons which would permit of negotiation, an armed peace and perhaps, ultimately, a relaxation of tension and disarmament on both sides.

Lockheed F-80 "Shooting Star" single-seater fighters over the Caribbean.

The Atom Bomb Extends the Limits of "Peace"

Thus either because they have no wish to open hostilities, or because they have not the means to do so, the two adversaries will not go as far a general trial of strength. However there remains the whole gamut of so-called secondary incidents, each of which would once upon a time have been a *casus belli,* but which have been relegated by the application of atomic energy to weapons of war to the level of misunderstandings, of localised disputes to be settled by discussions between the Major Powers. In fact, the destructive power of the atom bomb has not only reduced a

hundred-fold the numerical importance of strategic bomber fleets, but has also given to the world a new concept of "super war," so that all other, traditional, acts of war can now be committed without breaking the peace, and a state of war will not be considered to exist until the first atom bomb explodes.

This is probably only a temporary state of affairs, and may well disappear with the establishment of critical stocks of A-bombs on either side of the Iron Curtain, that is, with the production of a sufficient number of bombs to crush an adversary and cut off his sources of military supply, thus destroying his power of resistance. Once such stocks are in existence and both sides have the means to carry them safely and effectively to their targets, there will be no other solution but a general agreement to ban the atom bomb. Unless the plan is to use it on the battlefield—in which case all present-day military concepts will be overturned and guerrilla warfare will replace the forms of battle on which the strategists of both power groups have hitherto always based the military strength of their countries.

How Long is the Strategic Air Command to be Feared?

Rapid strides will probably also be made towards defence against what will doubtless become the conventional form of A-bomb attack, i.e. raids carried out by long-range bombers flying at very high altitudes. Most probably Soviet Russia will outstrip the USA in this respect, for the following reasons :

Ever since 6th August, 1945 (the date of the destruction of Hiroshima), perhaps even since Potsdam, when they were told of its existence, the Russians have been afraid of the atom bomb. On the other hand no one in the USA really believed that Russia would have this bomb before 1952. Up to July 1949 therefore America was seven years behind the Russians in the matter of defence against the A-bomb. Since then, but only since then, the same fear has gripped both sides of the Iron Curtain.

By demobilising practically all her military forces and retaining only the nucleus of a Strategic Air Command capable of carrying out A-bomb raids, the United States has for some time past founded her security on a single arm. This policy of offensive defence brought with it the natural corollary that Russia, on her side, should concentrate her efforts on passive defence. Such efforts, unenterprising as they may appear, had the advantage of being the only ones that promised any measure of success. There was no need to try and imagine what methods or equipment the enemy would use. It was sufficient to devote grey matter and funds to anti-atom defence.

The F-80 carries jettisonable wing-tip fuel tanks to increase its range.

The very fact that the atom bomb was dropped on 6th August, i.e. two days before the date agreed upon by the inter-Allied Staff in 1945 for Russia's entry into the Far East war (cf. Thomas Finletter, US Secretary for Air, in the *Saturday Review of Literature)* may well have assumed symbolic importance in the eyes of the Kremlin : henceforth, as now in the matter of the war against Japan, the United States, with her two-fold sources of strength, economic and atomic, could outstrip Russia or even limit her expansion. Even when it became apparent that America nursed no territorial ambitions, but was embarking upon a policy of financial support for the war-torn countries of Europe and Asia, it was simple for the Russians to base their reasoning on the past and to fear the consequences of this new inequality of strength resulting from the American monopoly of the atom bomb. Working from such premises it was natural that Russia should concentrate on (a) producing the atom bomb, in which she doubtless succeeded before July 1949, and (b) defence against the sole weapon capable of policing the world in general and the USSR in particular.

Finally, all are aware that eminent German technicians have joined the ranks of their no less eminent Soviet colleagues. Likewise everyone knows that from 1943 onwards the Third Reich, being powerless to deny entirely her air space to RAF Bomber Command and the *US Eigth Army Air Force,* had been at pains to develop the most effective defence possible against Allied air raids. True, the past seven years have complicated the problem, but its basic premises are the same. Then the raiders were "Lancasters" and "Flying Fortresses" flying at 250 m.p.h. and at an altitude of 15,000 to 20,000 ft. in large formations under cover of darkness or protected by their own fire power. Now they are B-36's and B-50's with a speed of 400 to 500 m.p.h. at an altitude of 35,000 ft., flying in much smaller formations. But there remains the problem of interception, i.e. of ensuring that the paths of two aircraft, or of an aircraft and a missile, meet at the right moment. And since 1943 development of such projects as the Me 163, "Wasserfall," "Schmetterling" etc. has been parallel to that of the bombers. In both cases speed, ceiling and efficiency have been very greatly increased. Such preoccupation with air defence (probably successful enough) was well in line with Russia's traditional defensive strategy.

Three Stages of Development in USA

Be this as it may, and whether or not the Strategic Air Command can long remain unchallenged, America has defined her initial strategy and succeeded in providing herself with the requisite equipment. It was incontestably the best possible solution of the problem of reconciling the demands of a peacetime economy with the need for a force

In Korea the F-80 was also used for ground support. A 100-lb. NAPALM bomb being dropped on a T 34 tank ; right the burning tank.

Two American Republic F-84 "Thunderjet" single-seater fighters (with wing-tip tanks) on convoy duty.

The well-known piston-engined fighter of World War II, North American F-51 "Mustang," can still be used for army support operations, thanks to its endurance and military load capacity.

sufficiently great to command respect. Protected by two oceans and by the Arctic wastes, being the sole possessor of the atom bomb and having a highly-developed aircraft industry capable of producing the most complex of heavy bombers, endeavouring to reconcile an out-dated isolationism with a new policy of global responsibility, anxious finally to reduce to the minimum the number of her sons permanently under arms, America had inevitably to confine her defence preparations to a force of heavy, long-range aircraft capable of carrying their load of atomic bombs over a quarter of the globe and returning to their base in home territory without landing anywhere en route.

It was very much later that the necessity for creating an adequate air defence system and providing the material required for this was recognised.

Truth to tell American designers do not seem to have devoted much attention, up until recent years, to interceptor fighters. Their chief concern has been for light escort machines for bomber formations. Whether it be through excessive confidence that their monopoly of the atom bomb would continue, or through pure conservatism and the attachment of excessive importance to the rules for yesterday's victory, they seem to have based all development on Allied experiences up to the end of the war. By increasing weight and power, substituting jets for piston engines in fighters and adding the former to the latter in bombers, American technicians have superimposed the technical developments of today, or rather of tomorrow, upon the ideas of yesterday. As a fighter the F-80 "Shooting Star" has neither the rate of climb to act as an interceptor, nor, powered as it is by a jet engine, the endurance to serve as an escort to the multi-engined bombers with their greatly increased radius of action.

Unhappy Compromises

At the end of the war designers and planners, their judgment obscured by the amazing performances obtained through the general use of jet propulsion, appear to have thought that it was possible to arrive at a compromise between the widely divergent, and frequently contradictory, demands of the tasks nowadays assigned to what we are still pleased to call the fighter arm.

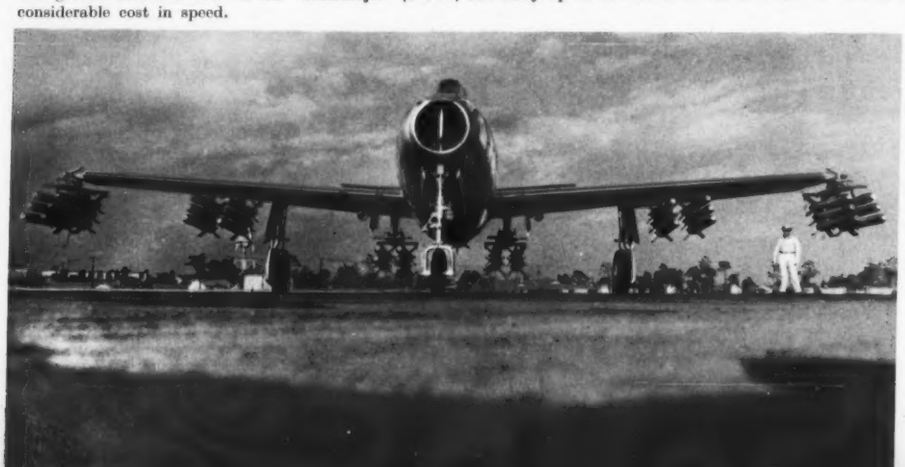
Even though by 1945 experience had shown that completely different equipment was required for tasks as dissimilar as combat at low, medium or high altitudes, day escort, interception of enemy aircraft at night, day bombing, reconnaissance, pure interception etc., and though piston engines, jets and rockets were used to propel single or two-seater aircraft of very varying characteristics, the American and British, and even the French, each began to concentrate almost exclusively on a single category of aircraft, represented roughly by the F-80 and F-86 in America, the "Meteor" and "Vampire" in Great Britain and the SO 6020 in France.

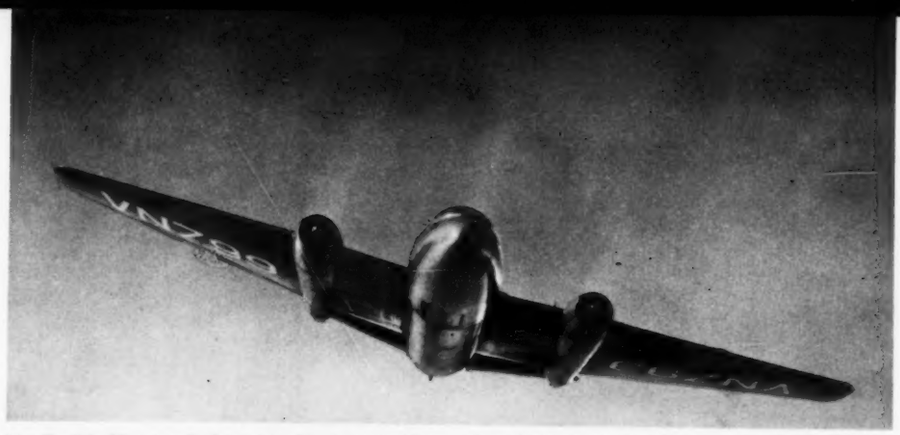
Thus when the great B-36 controversy broke out between the US Air Force and the Navy, it was a carrier-borne aircraft, the McDonnell "Banshee," which came into the limelight as an interceptor. It was found that this aircraft had the speed, rate of climb and manoeuvrability which the Navy required of a carrier-borne interceptor fighter. The USAF will probably have to be content with the installation of a combined rocket-jet in old airframes designed as a compromise between fighter and escort, or better, wait for the completion of the trials of specially designed types, such as the new F-86, the Republic F-91 and the new F-84 (F-96A).

The Tactical Aircraft has been Neglected

Bad as was the USAF position as regards pure interceptors, it was even worse where ground support and tactical aircraft were concerned. Interest in this type of weapon came third, after "strategic" and "defence" types. The mental processes here were quite natural. The "strategic" concept which was initially regarded as capable of solving all military problems unaided, was followed by the recognition that, now the atomic bomb monopoly was shared by the Russians, defensive air power would also be needed. Finally, having emerged from her isolationism and extended her line of defence right up to the Iron Curtain on the one hand, and being forced to take a positive stand in the Far East on the other, the United States grasped the necessity for possessing suitable tactical air forces.

The ground attack version of the "Thunderjet" (F-84E) can carry up to 32 rockets of 127 mm calibre—but at a considerable cost in speed.





The English Electric "Canberra" jet bomber, suitably armed, could be developed into a modern tactical aircraft.

Just as in the case of the interceptors, however, no special designs for such tasks had been prepared. Early this year Marshall Andrew in his "*Disaster through Air Power*" criticised the policies pursued by the USAF and demanded a powerful tactical air force. And James Haggerty, the aviation journalist, could find no better way of replying to him than to quote General R. M. Lee, Chief of Tactical Air Command, on the Republic F-84E, and add that at least 120 F-84E's will probably be purchased from the appropriations of the 1950 fiscal year, i.e. one tenth of all the aircraft acquired by the USAF during the current year. Even though the lessons of the war in Korea will scarcely hold good for other theatres of war because of the weakness of the air forces encountered on the North Korean side, it should nevertheless be remembered that the initial numerical inferiority of the American and South Korean troops could only be made good by the employment of ground support aircraft, or more exactly, of ordinary fighters hastily adapted for this new task.

In spite of all that has been said about the qualities of the "Shooting Star," it would appear that its principal merits are its endurance, its robust construction and the fact that it is available in numbers. It has not been found to be particularly successful in low-level operations, nor is it suitable for sustained employment on missions which, to be successful, must be continued day and night regardless of weather conditions and of the distance of the target area from the take-off and reception bases.

To fit auxiliary fuel tanks and batteries of rockets underneath the wings of the F-80 so as to increase its endurance and fire power must surely render vain all the designers' efforts to improve its aerodynamic qualities and thus increase its speed. It was a waste of time to refine the design of the wings and general structure if the resulting clean lines of this aircraft were to be ruined by hanging on it, as on a Christmas tree, all kinds of external tanks, bombs and rockets.

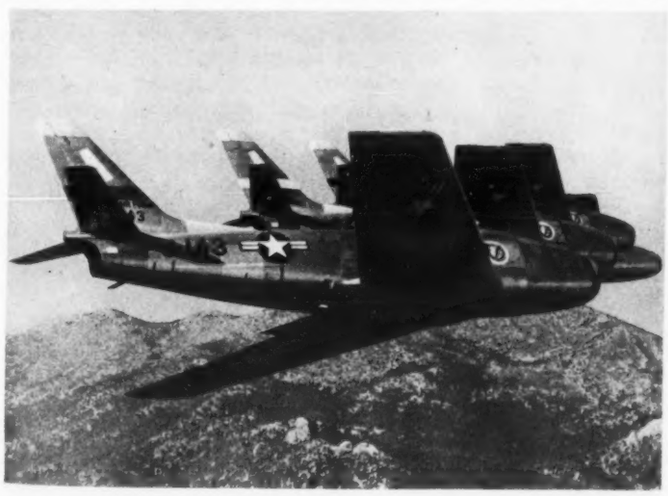
The British "Vampire 3" light fighter-bomber, like its derivatives the Mk. 5 (RAF and France), Mk. 6 (Switzerland) and Mk. 50 (Sweden), can be used as a pure fighter for medium altitudes or as a ground support aircraft.

In practice it is probably just as difficult to develop the medium combat aircraft, the result of the compromise between fighter and escort aircraft condemned above, into a good tactical aircraft as into a good interceptor. Here too this specialised task doubtless demands its own highly specialised machine. Is this to be a jet-propelled aircraft with large fuel tanks and a body wide enough to carry retractable armament, able to fly for long periods at low altitudes, but having an engine powerful enough to ensure its get-away in the event of attack by enemy interceptors ? Or must we return to a propeller-driven aircraft, with its greater range at low altitudes and its shorter take-off run, or, better still, combine these qualities with the advantage of speed by using a propeller turbine designed for the transonic range ? Should aerodynamic qualities be improved to the utmost, but weight increased by the installation of armour-plating, thus increasing speed at the expense of manoeuvrability ? Or is it better, by keeping down the weight to the minimum compatible with the strain on the structure, to insist on the manoeuvrability at low and medium altitudes which is an essential quality in the ideal ground support aircraft ?

It seems that not even the basic principles, the characteristics or the performance of a new tactical aircraft have yet been studied in detail. Much less has any serious attention been paid to its equipment and armament.

All observers agree on the importance of ground support operations. Even in its present form the ground attack aircraft is already a powerful instrument of destruction, accurate, relatively invulnerable and capable

The North American F-86 "Sabre" swept-wing heavy single-seater fighter was developed for use against stratospheric bombers. In addition to a speed in the region of 600 m.p.h., it has a remarkable range, so that it can also be used as an escort fighter.



of rapid action. All equally admit that it is based on an unwieldy ground organisation and above all that it cannot carry out sustained operations. This means that the enemy can re-take the ground or repair the installations during the night which are lost or damaged during the day. The ground attack aircraft of the Tactical Air Forces of the day were doubless adequate to hasten the end of a battle whose outcome was already decided, such as that in Germany in 1945.

If, as we shall see later, this ground attack aircraft is called upon to intervene at the outset of a conflict so as to make up for the numerical inferiority of the ground forces initially available, then in its present form, adapted from a different category of aircraft and lacking all specially-designed equipment, it cannot possibly accomplish the tasks it has been assigned.

Finally, two types of aircraft seem to be required. The light tactical aircraft suitable for operations against troop concentrations, lines of communication, light installations etc., must be backed up by a heavier machine, just as fast, if not faster, and equipped for raids on targets less suitable for attack by light rockets or cannon than for assault by bombs and self-propelled missiles. The latter category, different from the medium bomber which has today fallen into disfavour, has also been neglected by the designers of the Western world (1), though Ilyushin and Tupolev appear to have had these considerations in mind in designing their twin and four-jet machines.

France should have developed the tactical aircraft

Why this failure on the part of the Western nations to adapt their ideas to the requirements of modern air defence ? Because, until very recently, national strategy came before considerations of mutual defence. The United States thought in terms of defence by strategic bombing and succeeded admirably in providing herself with the appropriate air weapon. Great Britain thought along insular lines, of defence for her islands, and the best fighters are undoubtedly British, since they were designed from the start as pure interceptors.

As for support for the ground forces, nobody gave any very serious attention to such a problem since nobody really wanted to have any ground forces. In this respect it would appear that France, too, has failed to concern herself adequately with this problem. Forming as she does an integral part of the Continent, she should, whether she liked it or not, have given serious thought to providing effective support for her infantry, instead of fixing her gaze on Anglo-Saxon developments, not all of which answered her geographical needs or suited her industrial resources still suffering from the effects of the war. Nevertheless the example of the influence of the Spanish War on the outlook of the two great continental military powers, Germany and Russia, had been plain enough. As early as 1937-38 these two countries had reduced the proportion of medium and heavy bombers in their air forces, and, completely recasting their theories (especially in the case of Russia), concentrated primarily on creating a tactical ground support force which gave the Third Reich her initial victories and which, when the German and Russian armies confronted each other, helped to prolong the conflict, by equalising the opposing forces.

At that time the advantages of air support for ground operations were not so clearly perceived in France. This was because memories of the 1914-18 war were strong and because, following a line of reasoning contrary to that of the Germans, France's preparations for a future war were based on the concepts of the role of the aircraft which had led to victory in the previous one. Consequently the 1939 campaign opened with a "balanced" air force based on the lessons of the past, namely a large number of reconnaissance aircraft, some fighters and the nucleus of a bomber fleet. The Bréguet 691 and 693 ground support aircraft arrived too late and could not be used to full advantage, improvisation never being satisfactory in such matters.

The British Hawker P.1081 fighter (prototype ; series construction to be in Australia) has a speed of over 600 m.p.h. and is probably designed for use against high-flying bombers.

At the end of the second World War it was found to be extremely difficult, in view of the rapid technical advances of the war years and the considerable time lag between the design of a modern aircraft and its production in series, to work out any policy which would still be valid five or six years later.

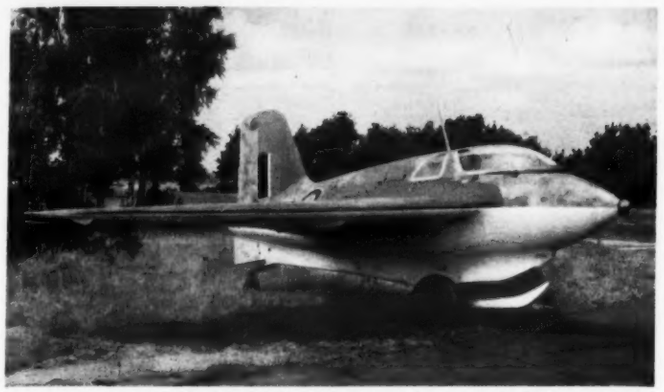
Either of two roads might have been followed towards providing a defensive air force. On the one hand, efforts could have been directed towards making up the time lost during the war by acquiring licences for the best and newest of the Allied aircraft types. On the other, counting on a long period of peace, France should have turned resolutely towards the revolutionary technical developments initiated in Germany, remembering the analogies between the defensive strategies of the two countries and the condition of their means of production, so greatly diminished by bombing in the one case and military occupation in the other.

If neither of these alternatives was followed it was probably because it was natural to count on a lasting peace and consequently to imagine that there would be ample time to repair, bit by bit, the intellectual and material damage suffered during the five years of the war. Man's folly has rendered these hopes vain. But it will be admitted that the first of these two possible solutions to the problem—construction under licence of the best Allied equipment—while providing quality material more rapidly, would have impoverished research. As for the second, long-term solution, it would have come to fruition too late, now that the international situation has precipitated universal rearmament.

Looking back now, the French air problem seems relatively simple. Part of this problem was substantially the same as that which confronted Great Britain, namely the provision of an effective defence aircraft. Apart from this, however, a purely national effort should have been made to develop a tactical

[1] The Martin XB-51 is the only aircraft in America and the "Canberra" in England which could be used for this purpose.

Modern French fighters : Dassault MD 450 "Ouragan" (left) and SO 6020 "Espadon" (right).



The German Me 163 fighter is now being developed in the Soviet Union under the name Yakovlev Yak.21. With an endurance of 10 to 20 minutes it is said to have an operational height of over 50,000 ft. reached in about five minutes ; maximum speed around 600 m.p.h.

America too has not forgotten the rocket fighter. The prototype of the Republic XF-91, fitted with a jet unit and a rocket engine, for air combat in the stratosphere.

air force. But the most striking of the lessons learned from the war by the Allies concerned strategic bombing and not air support of ground operations. Working with time on their side they had inevitably tended towards the development of an air arm capable of making its own decisive contribution to victory and reducing to the minimum the employment of the infantry which they desired to spare as far as possible. Unfortunately the financial means necessary for the creation of such an air instrument were lacking, so that between inability to create a strategic and reluctance to provide a tactical force, little or nothing was done.

Finally, at the end of 1947, M. André Maroselli, Secretary of State for Air, put an end to these waverings by ordering the "Vampire 5," this machine appearing to be the best available, since it could be used, at any rate for the time being, for either interceptor or ground support missions. Since then the "Ouragan" series has contributed towards an improvement in the situation as far as territorial air defence is concerned, and American aid has strengthened the French tactical air arm.

Agreement in Spirit but not in Fact

If all the general staffs and all the strategists have agreed on the decisive role that will be played by air power in the defence of Western Europe, there has been a considerable division of opinion on what shall be the instruments of this power. This is because, first, national strategies—or what was considered as the national strategy of a country—for many years came before any thought of a common strategy. Secondly, those nations who have emerged victorious from a previous conflict naturally tend to shy away from the mental effort required to adapt themselves to new conditions of warfare, and seek to base their future security on lessons drawn from their past successes.

Nevertheless during the past five years technical progress has been rapid and extensive :

1. The difference in speed between conventional interceptors still in service and the new tactical aircraft is slight. The F-84 flies almost as fast as the F-86, and when it was a heavy tactical aircraft, the B-47 reached a Mach number equal to that of the fighters which might have been employed to intercept it. This is only a passing phase, since the speed of sound is no longer a barrier to the aerodynamics experts of today. Nevertheless it is a very real situation which must be borne in mind, since it completely upsets not only all our notions of air supremacy, but also the form it has hitherto taken. Bombers can now penetrate into enemy territory without waiting for fighters to clear the way for them, since intruders have little to fear from interceptors.

2. When the new technical developments in methods of navigation and detection are applied to the problem of ensuring sustained air operations a new lease of life will be given to an air arm which has hitherto been able to operate only intermittently.

3. Effective cooperation between air and ground forces with all the advantages that speed, mobility, precision and fire power can confer on an arm specially designed for ground support, is the only way to lighten the tasks of the ground units. And since the Western Powers' political systems, economies and mental and moral standards are all against the permanent retention of mass armies, but favour the development of advanced technical aids, the air force must increase its share in operations so as to reduce those which can no longer be undertaken by the ground forces.

Disregarding all sentimental objections and habitual attachment to tradition, the primary obstacle to this concept is an economic one. To set aside for defence the same percentage of the national income as ten years ago is no longer adequate, the share of armaments in national expenditure having increased in proportion to the incomes of the most powerful nations, not to those of the others. Although the air force is still perhaps the best investment for a nation preoccupied with its defence, its cost bears no relation to what it was some ten years ago. The heavy bomber of 1940 in France cost a hundred times less than the light bomber of today and the fighter of yesterday fifty time less than today's. And prices are still rising. Thus, with engines constantly increasing in power, with essential air equipment for the present wide variety of missions becoming more and more complex, the necessary materials and labour will become more and more costly.

The Need for a Reasoned Materiel Policy

It is quite probable that if the West would agree to regard aircraft as fighting equipment instead of as armed transport vehicles, substantial economies could be effected. It is senseless to build a fighter, which is generally destroyed after less than 100 hours of flight, to the same standards and from the same materials as a commercial transport aircraft designed to fly 30,000 to 40,000 hours. Similarly it is surely paradoxical to spend millions on prolonging the life of a jet aircraft and bringing it up to 200 or 300 hours when after a third or even a quarter of this time the fortunes of war will have transformed it into a mass of scrap.

Experts are agreed on this point. It is quite possible to produce power units (jets or propeller turbines) with a life corresponding to the use to which they are to be put in battle, and costing considerably less than present-day models. Such engines have already been designed and constructed with good results. But love of achievement and pride in work well done, as well as fear of the risks involved in using them in peacetime, have prevented their further development and the creation of different standards for civil and military aircraft.

Here too respect for tradition runs the risk of being extremely costly some day.

Western Europe can be defended by air power, but only if the equipment used is specially designed for its theatre of operations and adapted to the new economy of armed peace.

The Role of Sea Power in European Defence

BY CAPTAIN NORMAN MACMILLAN, M.C., A.F.C., A.F.R.AE.S., F.R.S.A.

The object of sea power has remained constant throughout the centuries, but the methods by which sea power endeavours to attain its object have varied from time to time, and at no period has this change been more conspicuous than during the past quarter of a century. Even the technical methods and tactical practices of sea power which were developed during the last war have been modified since 1945 by developments in naval and other weapons. Thus, in facing its commitments in respect of European defence, naval power is confronted by a challenging new problem. The successful solution of this problem may prove to be the keystone of combined defence within this zone.

Before proceeding to a more detailed consideration of this subject, it will be well to define our terms of reference ; first, in what we mean by the "defence of Europe," and secondly, what we include under the expression "sea power."

For our purpose we must regard Europe as a Continent partly overrun by Asiatic overlords. The term defence must therefore apply to that part of the Continent which is still free from this political overlordship. That is, all Scandinavia, Western Germany and Western Austria, Italy, Yugoslavia, Greece and Turkey and all countries to the west of these peoples. Finland can be regarded as no more than a doubtful outpost, and the United Kingdom must be regarded as a principal naval and air base within the forward zone.

The term sea power I shall define as all that naval, military and air power which is required in order to secure the freedom of sea passage to and from the defined area. It includes not only naval ships and naval aircraft, but certain echelons of land-based aircraft which may not be naval in origin but will come under naval operational control, and certain harbour defences which may require army echelons to man them ; and still further it must rely upon adequate air defence of naval bases and shipyards, which may have to be provided by air force and not naval aircraft.

I have described the United Kingdom as a forward base for the defence of Europe. I believe that it may prove necessary to organize naval task forces capable of sustained operations without recourse to major bases. It may be necessary in certain events to operate these mobile task forces from bases in the Western Hemisphere, and provision should be made to enable this to be done at short notice.

There is also little doubt that naval bases should be prepared on the seaboard of West Africa, where they will be relatively secure from hostile air attack, provided they are sufficiently protected by radar and aircraft defence organization in depth.

The naval defence of the Eastern Mediterranean and the Middle East area generally, is now weakened by the political developments that have occurred there during recent years, from whose repercussions British naval power has lost vital bases. The danger here is that the Mediterranean may prove to be an even more difficult waterway to maintain as an open artery of communication than was the case during the years 1940-1942. It might prove difficult to move troops and supplies, airmen and aircraft through the Mediterranean and the Suez Canal, in which case Turkey and Greece might be isolated and overwhelmed. The defence of these peoples in south-eastern Europe in the event of major war is inextricably bound up with the policies of the States of the Middle East, Egypt, Israel, Syria, Iraq, Iran, Transjordan and Saudi-Arabia. These States, in fact, form a coherent part of the logical defence system of Europe, and if they remain outside such a system by a declaration of neutrality they will render themselves open to attack at the will of the enemy. For they form not only an avenue into Africa, and a pincer route towards the attack of Southern Europe, but they contain a wealth of oil supplies that make them a rich prize to a predatory Power, and further, they open wide the gateway to India. They cannot be protected by sea power alone.

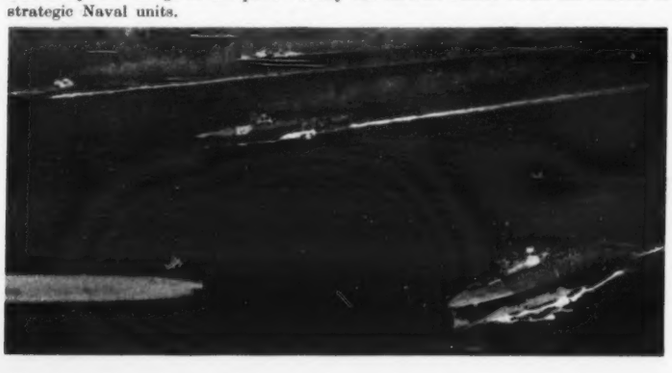
If the States of the Middle East are not prepared to enter into a defence agreement with the Western Powers, the main defence zones of the Western World can be clearly defined as falling into four groups : India-Ceylon-Burma-Malaya, the Americas including Canada, the Australasian group of islands including the Philippines, and the doubtful zone of Siam, French Indo-China, and Indonesia.

Sea Power will be required to maintain the bulk of the logistical effort to interlink these widely separated zones, and it is for this reason that Sea Power cannot be divided into packets. Its commitments are world-wide. Its strategy is global. It is the watchdog of the Western World throughout the world, and it can be regarded as having an integrated place within the defence of Western Europe only insofar as the tactical land and air forces demand its help, and then only in relation to the strategic demands made upon it in the other zones.

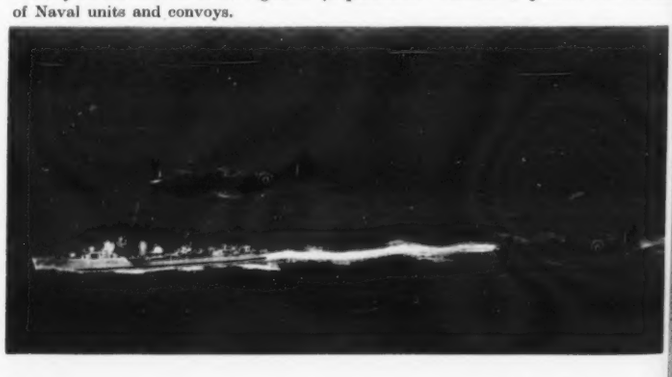
In fact, the situation is of a nature which requires an overall Admiralty of the Western Peoples to plan the allocation and activation of their combined fleets to meet the varying tactical situations that are certain to arise within the complete strategic picture. This Board should be based in the central zone, and there the principal naval bases should be sited.

This is a function not of State prerogative, but of geography. Clearly the correct main base locations of the combined fleet should lie upon the eastern and western seaboards of North America, from Seattle to San Francisco and Vancouver on the west and from Bermuda to the Hudson and St. Lawrence Rivers in the east. The eastern naval

Battleships are things of the past. Today the aircraft carrier forms the nucleus of strategic Naval units.



Destroyers and carrier-borne fighters (Supermarine "Seafires") protect the flanks of Naval units and convoys.



force would be responsible for all Sea Power commitments thence eastward to Malaya. The western naval force would be responsible for all Sea Power commitments throughout the Pacific and westward to Malaya.

The arm of Sea Power applied to the defence of Europe would then operate naturally and flexibly throughout all zones affecting the logistics of European defence ; it would be able to use every available base within the North and South Atlantic oceans, the western coastline of Europe, the Western Mediterranean basin, Africa (perhaps excluding Egypt), Ceylon and Singapore, and possibly India and Pakistan.

*

This is the picture one must keep in mind all the time when considering the role of Sea Power in the defence of Europe. Its function is not like that of the army, to maintain continuous contact with the enemy in defence of territory, nor like that of the air force, to give the army continuous direct aid and to defend by semi-static defensive measures the forward bases on which the armies and tactical air forces depend.

The function of Sea Power is fluid, exerting pressure where it is most required at any given moment, and it derives this strategy directly from its own inherent quality of self-sufficiency in transportation. It is essentially a mobile form of power, and to curtail its mobility and power of manoeuvre, its ability to move secretly and strike unexpectedly, is to limit its strength by fettering its freedom.

These are the considerations which determined that the Flag Officer Western Europe was no more than a Liaison Officer at the headquarters of the Supreme Commander Western Europe, although he possessed the authority of a full member of the planning committee within that organization. He is, indeed, a landlocked admiral, without a fleet. His function is to contribute the naval viewpoint to the work of the Commanders-in-Chief Committee, to ensure logistic support for the land and air forces reinforcing Western Europe, and to transmit to the naval authorities concerned with functional allocations the needs of the Supreme Commander for amphibious operations and naval support. Obviously it is immaterial to such a Flag Officer whether his requests for naval action are met from the United Kingdom or from the United States, provided that they are met at the correct moment in the required proportions.

The defence organization of Europe is divided into separate land zones : Northern Europe, Western Europe, Southern Europe and South-Eastern Europe. Each zone would require its own overall Supreme Tactical Commander, each presumably advised by his own attached Flag Officer. A Supreme Overall Commander would be required to correlate the different forces in Europe, and with him would be a senior Flag Officer responsible for the disposition of the naval requirements of the individual force Flag Officers. That senior Flag Officer would be responsible for the main advanced base organization. His requirements would be met from the Combined Admiralty Headquarters on the eastern seaboard of the United States.

The days of great Battle Fleets are over. Even the air developments of the 1939-1945 war were sufficient to show that the power of the battleship was then challenged almost to the point of extinction by land-based air power, and in favourable circumstances by naval air power. The arms race for main battle fleets belongs to a past epoch in preparations for war. Moreover, the potential enemies of Western Europe are continental Powers, not naval Powers. Their strength lies mainly in their armies backed by ground armour aided by tactical air fleets ; their strategic air fleets are growing, but at a relatively slow rate. They do not possess great surface fleets, and have never done so because of their own geographical situation. The chief naval threat from the enemies of Western Europe is the submarine.

When war began in 1939 Germany possessed 51 submarines in commission. During the course of that war she deployed a maximum of about 300. Today it is estimated that Russia possesses between 270 and 350 submarines, many of which are short range coastal vessels, but some of which are long range cruising submarines. The most widely used German submarines could remain at sea for three months, when refuelling ships (which were sometimes themselves submarines)

The submarine : enemy No. 1 of every sea power. The Soviet Union has several hundred under-water craft, including a large number of long-range submarines. Speed and length of time a submarine can remain submerged have been increased by the use of Snorkel tubes and rocket motors, and the surface range extended.

gave them fuel and armament supplies. The longest-range German submarines could cruise on the surface for 30,000 miles. Since the war ended in 1945, submarine development has not ceased. These vessels may now be driven by motors using selfoxygenating fuels when under water, thus dispensing with the need for the Snorkel tube which the internal combustion engine requires for breathing air. The crew can be provided with sufficient compressed air and oxygen supplies to travel under water for considerable periods. With these developments the submarine which formerly could remain submerged propelled electrically at speeds of about 8 knots for rather less than one hour, may now remain submerged for longer periods while travelling at much faster speeds. This weapon has therefore become a more formidable threat to the security of sea logistics, both in the number owned in peacetime and in its scientific development.

Already the methods that were used to counter the German submarine campaign are out of date. More and faster surface ships are required to deal with the new type submarines. More aircraft are necessary to deal with the larger submarine fleet at the first moment of aggression. New shipborne and airborne equipment are required to detect the submarine equipped either with snorkel or self-oxygenating fuel motors.

Something has been done to deal with the new submarine threat. New corvettes are being built to sail at faster speeds. New aircraft carriers are being laid down. New types of antisubmarine aircraft are

Land-based anti-submarine aircraft—American Martin P4M-1 "Mercators" (above : two P & W "Wasp Major" plus two Allison J-33 engines) and British Avro "Shackleton" (below : four Rolls-Royce "Griffon" engines)—protect harbours and sea routes from underwater attacks. They are fitted with the latest electronic detection equipment, sound buoys, bombs and depth charges.

Carrier-borne anti-submarine aircraft, such as this two-seater Blackburn YA-5 with Rolls-Royce "Griffon" engine (the series model has three seats), escort the Naval units. Bomb bays and retracted radar blister are clearly visible.

High performance fighters with propeller-driven engines, such as this Hawker "Sea Fury 11" are still the principal carrier-borne aircraft.

designed and designing. Existing types are the four-engined Martin P4M-1 "Mercator" and Avro "Shackleton," the three-engined North American AJ-1, the twin-engined Lockheed P2V "Neptune" and Short SB3, the single-engined Fairey 17, the Blackburn YA1 and YA5. The Short, Fairey and Blackburn types are operated from carriers; the AJ-1 and P2V can be used from carriers under special conditions. All these aircraft are designed to carry the latest radar submarine search equipment, including sonobuoys, and take bombs or depth charges to attack their targets when discovered.

But until the new type submarines and the new type aircraft and antisubmarine equipment are put to their relative tests in warfare it is impossible for anyone to estimate the comparative efficiency of either in the new circumstances. The results of the last war are already out of date in this branch of naval war and an unreliable guide to the future.

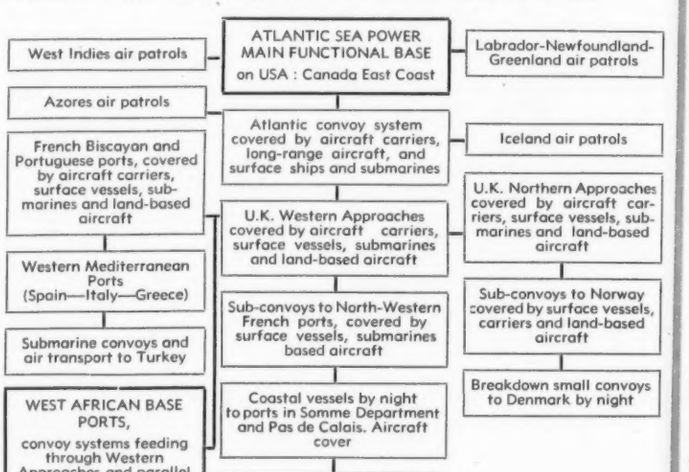
What about the flying-boat? Besides the Avro "Shackleton" of which only a small number has so far been delivered, Coastal Command of the Royal Air Force still operates very largely with last-war aircraft. Flying-boats have been gradually disappearing from the skies and their place taken by land-planes which are assumed to be easier and quicker to service, and relatively more efficient in range. Recently the US Navy has taken delivery of the Convair XP5Y-1 four-engined propeller-turbine prototype flying-boat, of which a small series is under construction. It is possible that, after experience has been gained with types like the Saunders-Roe "Princess" 140-ton flying-boat, such aircraft might be used for antisubmarine work, but they take time to build and the loss of a few in war might have serious consequences if they could not be replaced quickly.

The object of the submarine is to blockade an enemy by attacking and destroying his seaborne lines of communication and supply. The object of defence in sea power is to keep those supply lines open. In the present relative state of sea power between the Eastern and the Western Powers, the Admiralties of the West are compelled to place the submarine as naval enemy number one. Not only can the submarine carry torpedoes and mines but may prove to be one of the most deadly carriers of atomic weapons. With the advent of the atomic weapon it can be used not merely to destroy ships, but to destroy, or damage severely, the harbours without which the ships themselves have no power to complete the task demanded of them.

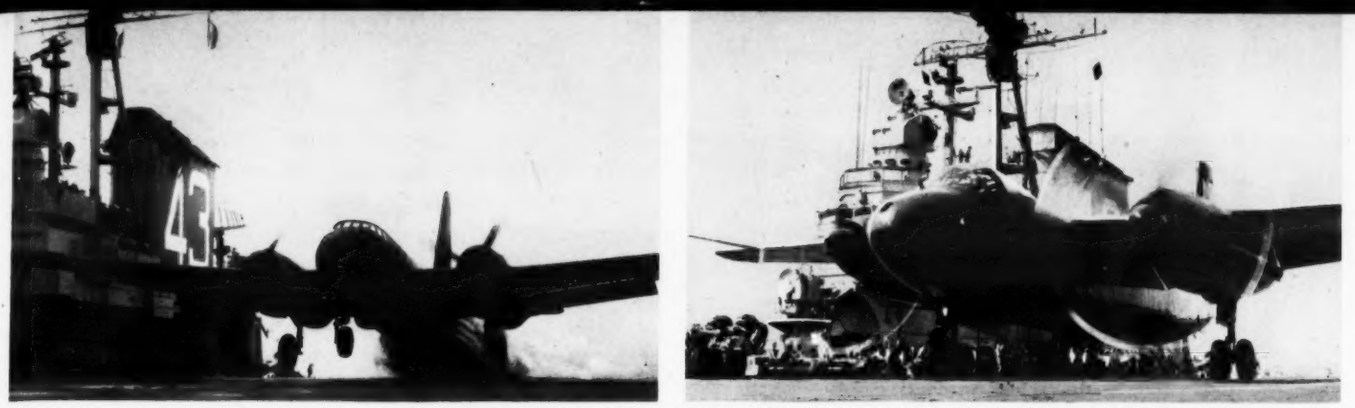
It is the role of sea power in the defence of Europe to ensure not only the security of passage of the merchant ships upon which the army and air forces are dependent, which bring food and essential raw materials to the defenders of Western Europe, but also to ensure that the harbours upon which those vessels depend are secure. It is the role of sea power further to make provision for types of vessels which may be able to fulfil the logistical requirements of the Western European defence system even if the harbours are denied to them by enemy action. During the invasion of Europe in 1944 it was found impossible to maintain the flow of materials and men to the forces of liberation by beachhead logistics alone. These methods were sufficient for the initial build-up and the earliest reinforcements. But they were insufficient for the immense movements required later when the lines of contact with the German forces stretched across the Continent. In that later stage, it was essential to have the facilities of a great port, and the conquest and clearance of the entrance to Antwerp became a key operation in the major strategical requirements of the autumn of 1944.

In an age when it is possible for atomic weapons to render major ports unusable, both by destruction of port facilities and by contamina-

SUGGESTED NAVAL ORGANIZATION CHART FOR THE DEFENCE OF EUROPE


ATLANTIC SEA POWER MAIN FUNCTIONAL BASE on USA : Canada East Coast
West Indies air patrols
Labrador-Newfoundland-Greenland air patrols
Azores air patrols
Atlantic convoy system covered by aircraft carriers, long-range aircraft, and surface ships and submarines
Iceland air patrols
French Biscayan and Portuguese ports, covered by aircraft carriers, surface vessels, submarines and land-based aircraft
U.K. Western Approaches covered by aircraft carriers, surface vessels, submarines and land-based aircraft
U.K. Northern Approaches covered by aircraft carriers, surface vessels, submarines and land-based aircraft
Western Mediterranean Ports (Spain—Italy—Greece)
Sub-convoys to North-Western French ports, covered by surface vessels, submarines based aircraft
Sub-convoys to Norway covered by surface vessels, carriers and land-based aircraft
Submarine convoys and air transport to Turkey
Breakdown small convoys to Denmark by night
WEST AFRICAN BASE PORTS, convoy systems feeding through Western Approaches and parallel systems, and itself fed through trans-African supply system connecting with India—Malaya Group
Coastal vessels by night to ports in Somme Department and Pas de Calais. Aircraft cover
Antwerp heavily defended by aircraft and A-A defences and fed from U.K. breakdown ports

Faster jet bombers and low level attack aircraft necessitate faster defence fighters. Certain British carriers are already equipped with Hawker "Sea-Hawks" (left) and Vickers-Submarine "Attackers" (right).



Take-off and landing trials on board the American aircraft carrier "Coral Sea" by the Lockheed P2V "Neptune" atom bomb aircraft (left) and North American AJ-1 low level attack bomber (right) are designed to determine the practicability of operating long-range heavily-armed aircraft from carriers. Targets far in the enemy's rear, such as atomic power centres, fuel depots, submarine bases etc. are now open to attack by a sea power.

tion of the area by radioactive water, the outlook must be changed. Those responsible for sea power must take the necessary decisions in respect of the completion of the logistical operations for which they are responsible. It appears that the future demands of sea power for logistical security upon the sea lanes may require the allocation of special airborne military forces which can be deployed to destroy the enemy threat of submarine atomic warfare at source instead of at sea.

By all means let us press on with all technical preparations to defeat the submarine at sea, but let us not overlook the even more vital necessity to develop ways and means to defeat the submarine threat before it ever gets to the sea.

Carriers require not only fighter, torpedo-bomber-reconnaissance, and antisubmarine aircraft, they require also the most efficient special air service aircraft capable of transporting Marine commandos on special missions to attack far inland targets that threaten the safety of the seaborne supplies on which Western Europe's defence is planned, and without which it could not be made effective. These Commando operations may well be semi-suicidal in nature, but men have always been found to volunteer for such hazardous operations in the past, and they will be found again should need arise in the future.

The great strategic role of sea power as it existed in the time of Philip II of Spain and Elizabeth of England, in the time of Napoleon and Nelson, and towards the end of the first German Empire, has ended. Sea power used militarily at sea is tactical, the protection of logistical transports from air, surface, and underwater attack, the shore bombardment by naval guns and aircraft. The strategic role of sea power must now be directed to the demolition of targets on land—the destruction of atomic weapon manufacture, the reduction of enemy oil supplies and resources, the destruction of his oxygen and hydrogen peroxide and heavy water plants, the destruction of his plants and shipyards for the manufacture of submarines. And, just as the Continental Powers of Asia will concentrate to destroy the seaborne logistics of the Western European peoples, so must they in turn seek to destroy the overland logistics of the Continental Powers.

Thus, although the world-wide logistical strategy of sea power demands the segregation of sea power control into one centralized zone, the implications of defence against the enemy's probable form of attack upon sea power demand a still closer integration of offensive strategy between all three arms in order to achieve that aim. And so the land-locked admiral has another function, in addition to that envisaged for the Flag Officer Western Union, for it seems certain that a considerable portion of the power of the land and air force Services will be required in order to make it possible for sea power to fulfil its normal role in the defence of Western Europe.

Germany's Contribution to Western Defence

BY DR. ROBERT KNAUSS

The participation of Germany in the defence of Europe is inevitable, regardless of what political obstacles, both domestic and foreign, there may be. It is better to accept the inevitable, rather than to strive against it. History is inexorable; its pages cannot be turned back, and when the Marshall Plan was extended to the Western Zones of Occupation in Germany and the Federal Republic was created, the die was cast. We Germans had opted for the Western way of life, for Europe and the Atlantic Powers.

Whoever today rejects the principle of Germany's military participation decides, whether he will or not, in favour of the absorption of Western Germany into the Soviet *bloc*, with all its consequences.

There is no middle way.

It is inconceivable that we could remain neutral observers half way between West and East, while the armies of the Atlantic Powers defend our Eastern frontier. Moreover the American Defence Minister, General Marshall, has stated that the number of American divisions to be sent to Europe will depend on whether German troops are included in the defence system or not.

Defence of the Elbe however would only be worthwhile if it were based on *mutual obligations* and if German manpower and armament potential were built into a common front. From the moment a German contingent is incorporated into a European defence force the Federal German Republic must cease to be regarded as a buffer. Its territory can no longer be held or relinquished at will, but becomes an integral part of the European defence system. And the economic potential of Western Germany? Not for a moment may it be allowed to fall into enemy hands . . . This West German territory is no longer just a "strip of land" some 435 miles long and 250 miles wide, where the tank strategists of both sides can fight out their battles. If in such vicissitudes of modern warfare a German élite, which is still morally proof against Bolshevism, should go to the wall, the German people would quite simply fall victim to the Russian steam-roller and be lost once and for all to the Western world.

The full scope of this principle however can never be appreciated by a foreign "protective force" which comes 4000 miles across the ocean to hold an "outpost," This principle

can only be fully defended by Germans, because they are most closely threatened, because they experienced Bolshevism at first hand during World War II. Then there is a military advantage... Four years of bitter struggle made the German soldier into the most experienced of all adversaries of Russian methods of warfare. No other European country has this experience.

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There are *two primary obstacles* to be overcome before Germany can be incorporated into a European defence system, one psychological, purely German, and the other foreign. In other words, the Germans have no desire to be soldiers, certainly not until the Federal Republic is recognised as a partner with equal rights; and this demand for equality meets with the greatest opposition from the French, who fear that a revival of German military power might threaten their security tomorrow. These two attitudes are of course closely interconnected.

All this opposition, regardless of its differing forms of expression, springs from unreasoning instincts and out-dated prejudice. It is contrary to all political common sense.

The prejudices feed on the past, and prevent a clear view of the future. Basically every Frenchman and every German knows that a European army, and with it a German contingent, must come. In point of fact it is probably only a question of time before this political necessity is universally recognised. The tragedy of the present situation, however, is that time is vital, that we cannot wait for a gradual awakening.

*

Let us take first the *problem of the German attitude to military service* ... not because I am a German and might thus see this internal German problem through a magnifying glass, but because I am convinced that it is the most difficult of our present problems.

Foreign countries express surprise that Germans are not rushing with wild enthusiasm to put on their uniforms again and crowd into the barracks. Apparently people outside Germany imagine that the normal German asks nothing better than to throw his civilian career to the wind, and give up all thoughts of profit and freedom for the joy of living under military compulsion for two years. But it must be recognised quite soberly that out of thousands called up for military service there are never more than a handful who really enjoy being soldiers. Leaving professional soldiers aside, these are not always of the highest intelligence and consequently not the best. This applies to all nations. Military service represents a personal sacrifice, and the word "sacrifice" alone implies that it is not a question of pleasure but of painful necessity.

Under Hitler the Germans were not asked whether they wanted to serve with the armed forces, any more than are the men of any other country which has universal conscription. Today, however, the Germans are being *asked* whether they would like to be soldiers or not, and there is even talk of a plebiscite on this question. The question itself is badly expressed... It should not be: "Do you want to be a soldier ?" but: "Are you prepared to make a sacrifice to defend your home, family and freedom in the event of an enemy aggression ?"—If the Germans—men and women, for women are just as important here—were asked *in this way*, they should not find it difficult to decide.

It must not be forgotten—a mistake which other countries fall into from time to time—that the German is burdened by an emotional handicap in his attitude to military service. The last war was, it is true, begun as a "crusade against National Socialism," but it ended as a "crusade against militarism." And ultimately a militarist was any German soldier, even if he did nothing more than his duty. Leaving aside war trials, dismantling and decartelisation, everything was done to drive all thought of the citizen's duty to defend his homeland from the mind of the Germans. A soldier's career was made to appear despicable, and officers and men deprived of their rights.

Can it be wondered that after experience of this kind, which has bitten deep into the German people, the youth of Germany should evince so little interest, not to mention enthusiasm, for military service ?

Willingness to serve, however, is an essential prerequisite for the creation of a German contingent. Without it, it is useless to talk about numbers of division, organisation, equipment and armament or to make plans regarding the nature of the command. We are convinced that the technical problem is the simpler one and can be solved rapidly enough when once this willingness to serve is established.

The Germans must be told *why* they have to become soldiers, *why* they have to make sacrifices.

Our meaning here can be illustrated far better by an example than by long theoretical explanations. A high school teacher recently asked his 17-year-old pupils to write down their views on re-militarisation. The best essay was produced by a boy who described how he would be called up in 1953, drilled on the barrack square and shouted at by the sergeant-major. All this might be expected to lead to the conclusion: "Never again !" —What however was his final sentence ? "...And yet I shall be a soldier, because I do not want to go through the experiences of 1945 again, when as a child I had to flee before the Russians with my mother."

This schoolboy's essay contains another truth: *The Germans have had enough of the old military system.* They want no restoration of the Reichswehr or the Wehrmacht. Many of the old practices, such as heel-clicking, goose-stepping and the NCO's bark, which have no place in our age of jet fighters, rocket missiles and radar, must be done away with. We Germans do not need any special military code of distinctions. There should be only *one* distinction, the same for all. Uniform is worn when on duty; elsewhere it has no place. True inner authority can no longer be derived from a uniform, and anyone who has to rely on his badges of rank in order to maintain discipline has no business in a position of authority. In the factory neither managers nor foremen wear badges of rank and yet each one has his place in an invisible but effective hierarchy.

Wherein must a further difference between the German soldier of yesterday and of tomorrow lie ? First of all, the men of the German contingent, from the top to the

"... *Let us not talk of military enthusiasm* ..." Caricature from the programme of the Düsseldorf cabaret "Komödchen."

bottom, must support their own democratic state from inner conviction. This, however, presupposes thorough political education and training. What was wrong with the Reichswehr under the Weimar Republic ? First and foremost that officers, NCO's and men, though officially non-political, in reality rejected and derided the democratic State. The average troop commander was proud of the fact that he never paraded his unit before the first President of the German Republic. The new German soldier must think politically, but not on party lines. He must regard himself as a citizen in arms, and must use his right to vote.

We also consider that in any future German contingent professional soldiering should make way for a *militia system*. The soldier's job—even in the technical branches such as armoured, air force or signals units—does not take many years to learn. The Swiss militia system proves this. The man who has a civilian career behind him and knows that he can get on in the world outside his military service, will generally be the more honourable soldier.

Considerations of this kind become particularly important when we remember that the German soldier of tomorrow will be a member of a European army. Flyers today like to assert that they think supra-nationally. And it is true the universal aviation language is English. Thus knowledge of languages is an important requirement not only for the airman but also for every soldier in tomorrow's European army.

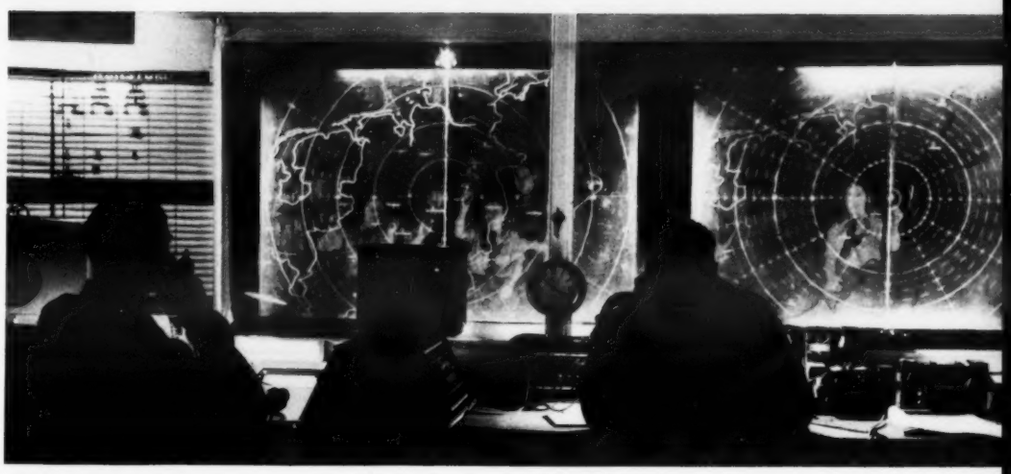
Air Defence ?

I shall refrain from going further into details of the domestic and foreign political requisites for a German contribution to the defence of the West. I shall also refrain—since there are very many problems to be solved first—from discussing military details, such as strength, organization, armament and training of a future German contingent.

My reason for discussing one special technical aspect at this stage is to show from the *example of air defence* that this too can only be organised on a *pan-European basis.*

Discussions of the rearmament of various European countries nearly always confine themselves to considering the number of divisions, their type and armament. As if modern wars were fought out only on the ground ! It almost seems as if the same old mistake were being made of preparing for the last war instead of the next.

However, Europe can defend herself against



British radar control room.

day and night bombing and remote-controlled rockets only if she covers her territory with a *uniform, unbroken radar network.* The foundation of modern air defence is radar and radio control...

We are seriously concerned that the tank strategists of the last war will overlook this fact, because they are not aware of it. And they are not aware of it because at the time they were attending their military academies, radar was not yet invented. Even today it is a "hidden" science, rather like nuclear physics. But even the last war, from about 1941 onwards, was a radar war at sea and in the air. Let us remember that the German submarine campaign broke down when British and American aircraft escorting convoys were fitted with centimetre radar instruments.

The tasks of the radar service are manifold. Approaching enemy bombers must be picked up in good time and their movements constantly watched. Only then can the population be warned in time, only then can fighter forces be employed successfully. For this, however, the *whole of Europe must be covered with a network of radar stations.*

A large omni-directional radar instrument can scan an air space approximately 300 miles in diameter. The plots provided by the individual radar stations are collected in the control room by means of television receivers, and between them give an up-to-the-minute picture of the situation in the air. This enables the various command posts to take the requisite measures—air raid warning, fighter operations, radio jamming, etc. Another important task, in addition to keeping a watch on enemy aircraft, is monitoring the enemy's radar service on all wave bands. Even during the last war German radar observers were able to detect the switching on of airborne radar equipment on British airfields half an hour before the take-off of the bomber units and thus give a peliminary warning of attack. The object of jamming is to cripple the radar instruments of approaching units. It was thanks to such jamming that the two German battleships "Scharnhorst" and "Gneisenau" were able to slip through the Channel (this has recently been confirmed in the latest volume of Churchill's memoirs. Ed.)

Closely connected with the use of radar for the military purpose of air defence is the question of *flight safety.* In peacetime ground organization and flight safety service are used by both civil and military aviation. However, the methods of safeguarding flight hitherto used, differing as they do from place to place, can no longer cope with the steadily increasing volume of air traffic, particularly in bad weather. All aircraft, regardless of nationality, should be guided, preserved from collisions and supplied with navigation and blind landing instructions by a uniform system of movement control.

*

We have chosen two special cases from the multiplicity of problems that exist today, and have endeavoured to show that it is no use sitting down to an empty table. It is useless to talk about a German contribution to Western defence until there are German soldiers.

No plans can be made for a European army unless uniformity of planning is first ensured. This is illustrated by the example of air defence.

Where is the European soldier of German nationality ?

Where is the radar network covering the whole of Europe ?

The Price of Western Defence

Some Economic Problems of the Atlantic Powers

Why taxation cannot be reduced

Some forty years ago even the least military-minded among the older citizens of Western Europe made a habit of attending every possible military parade... because as tax-payers they were determined to "see something for their money." Nowadays they would scarcely get their money's worth, even if they spent all their time, day and night, on the parade ground—armaments today are far too costly.

The American War of Independence was waged at the relatively modest cost of 370 *million* dollars. World War II (from 1st July, 1940, to 30th June, 1946) cost the USA 370 *thousand millions* (Annales de Finances Publiques, 1947, No. VI—VII), i.e. the American contribution to the cost of the war was six thousand million dollars—a month.

Today even such a relatively limited peace-time operation as the Berlin airlift swallows up 270 million dollars. And the cost of war material for Western re-armament is many times greater than World War II prices.

A glance at the increase in price of American military aircraft is enough to explain the rapid rise in defence estimates. What did the bomber of World War II cost ? A Boeing B-17 "Flying Fortress" came to $238,000, and even the mighty Boeing B-29 "Superfortress," which played such a vital part in the war in the Pacific, cost only $640,000. Today the USAF must pay $5,760,000 for a Convair B-36 long-range bomber. For the price of a squadron of thirty of these aircraft three sky-scrapers as big as the Empire State Building in New York could be built.

The increase in the price of fighters is no less staggering. A standard World War II type, the North American F-51 "Mustang" cost $55,000. Present-day jet fighters cost between $500,000 and $800,000.

Transports ? The cost price, $2,350,000, of the modern Douglas C-124 "Globemaster" is eight times as great as that of its predecessor, the Douglas C-54 "Skymaster" ($310,000).

Needless to say, it is not enough just to buy aircraft. They must also be flown. The following is a comparison of the purely operating costs per hour for war-time and post-war aircraft types *(not counting* costs of personnel, ground organisation, depreciation, etc.) :

	Net operating cost of World War II aircraft per hour.	*Net operating cost of present-day aircraft per hour.*
Bombers :	Boeing B-17 : $96.97 Boeing B-29 : $233.32	Convair B-36 : $1,024.17
Fighters :	North American F-51 : $62.92	Lockheed F-80 "Shooting Star" : $120.18
Transports :	Douglas C-54 "Skymaster" : $97.71	Boeing C-97 "Stratofreighter" : $272.40

To put it more clearly, the cost of the fuel and lubricant for a single hour's flight by the B-36 long-range bomber is twice the monthly salary of the average American office worker, who earns 400 to 500 dollars a month. And this brings us to the basic problem ; who is to pay for all this... and—almost more important—who is to produce it all ?

Money alone is not sufficient

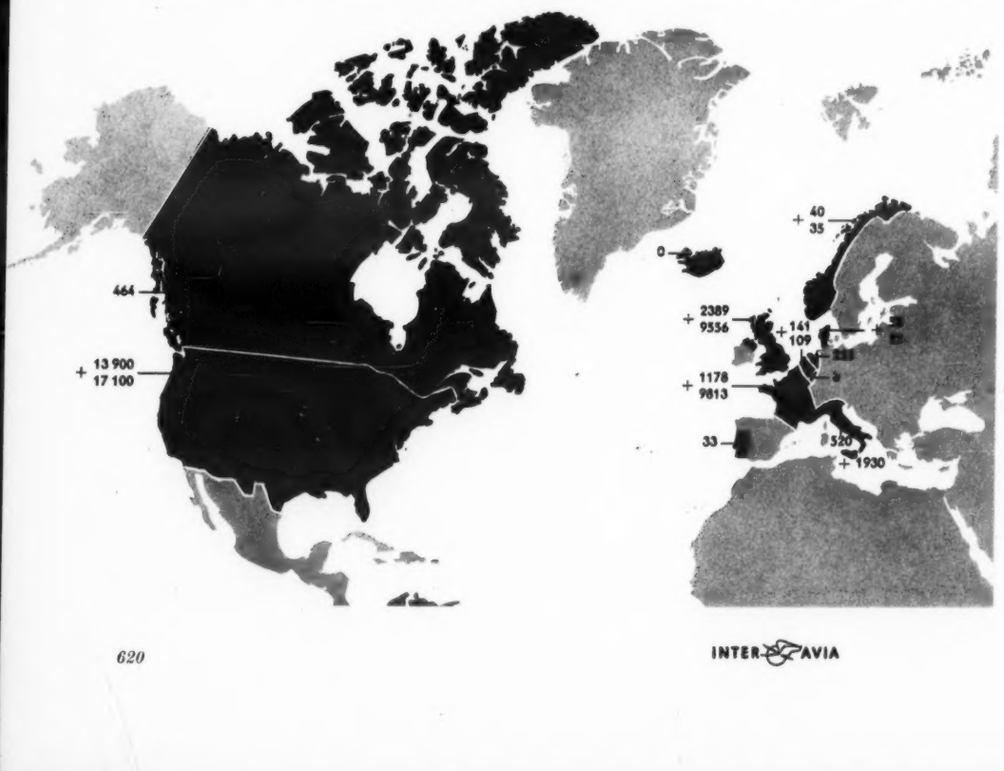
In the days when it was considered that all that was required for war was money, money and yet more money, the phrase "intricacies of modern economy," so often cited today, was but imperfectly understood. True, money still plays a vital part in modern armament, but it has long since been ousted from its former role of "star" by a multiplicity of others demands and requirements, a fact which was very soon brought home to the Americans in connection with the present re-armament drive by the Western powers.

Without doubt the first thing to be done was to provide the necessary funds. This the USA has done in most generous fashion.

On 27th September, 1950, President Truman signed an "Emergency Supplementary Appropriations Bill" (for the 1950-1951 fiscal year), in passing which Congress had exceeded the President's original request by nearly a thousand million dollars. The major part of the $17,192,000,000 approved will be used as follows :

The three armed forces of the USA[1]	$11,650,000,000
Additional arms aid to Western Europe, Greece, Turkey, Persia, South and East Asia (including the Philippines)	$4,000,000,000
Increasing stock-piles of vital war raw materials	$600,000,000
Atomic Energy Commission	$260,000,000

Here it must not be forgotten that in the ordinary American budget for 1950-1951 over



[1] The air forces of the USAF and the Navy are to get 8,700 aircraft between them so that their fleets will be brought up to 17,000 and 7,335 aircraft respectively by the middle of 1951.

Ordinary and extraordinary defence expenditure of the Atlantic Pact countries, based on the most recently published defence estimates and special armament plans (three and five year plans). First figure : ordinary credits for 1950-51 or 1951-52. Second figure : special credits. *In millions US dollars.* (The same credits in millions of local currency : USA : $13,900 + $17,100 ; Canada $483 ; Great Britain £480 + £3400 ; France Frs. 420,000 + Frs. 3,500,000 ; Belgium Frs. 7092 + Fr. 5500 ; Holland Fl. 852 ; Luxembourg Fr. 134 ; Italy 323,000 lire + 1,500,000 lire ; Portugal Esc. 970 ; Norway Kr. 282 + Kr. 250 ; Denmark Kr. 358 + Kr. 150.)

one third of the total expenditure was for national defence, viz :

Defence expenditure in the American budgets for the last three fiscal years (1st July—30th June)[2]

1948-49	1949-50	1950-51
Total expenditure :		
40,057,107,858	43,296,604,927	42,438,757,400
Army :		
7,736,536,399	6,200,879,568	5,329,918,319
Navy :		
4,441,566,772	4,413,446,491	4,160,109,171
Air Force :		
1,800,281,666	3,745,000,000	4,415,000,000
Atomic Energy Commission :		
620,937,630	672,971,274	816,754,000

Now it might be supposed that these astronomical sums (13,900 million dollars in the ordinary budget + 17,100 millions from the supplementary estimates = 31 000 millions) were to be spread over several years. But this is not the case. On the contrary, most of the additional arms and equipment planned is to be produced within a single financial year.

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Even the man in the street will begin to ask himself where all the *raw materials and factories, tools and labour* for this huge programme are to come from.

Far from coming at a time of economic depression, such as existed in the years before World War II, today's re-armament programme must be completed in a period of world-wide boom. There is no question now of unused stocks of materials, lack of work or unemployment.

These then are the questions which are causing the planners in the Atlantic Pact countries far more concern even than the problem of finding the money for arms production.

According to figures published by the Aircraft Industries Association of America (AIA), the price of the most important raw materials rose by the following percentages between the beginning of the year and July, 1950 : aluminium 3 %, tin 15 %, copper 18 %, zinc 39 %, rubber 61 %. And on 3rd October, 1950, Under-Secretary for Air John McCone stated before the Defence Committee of the American House of Representatives that this upward trend had continued even more rapidly since the Korean conflict, e.g. tin 33 %, copper 23,6 %, rubber 129 %.

In spite of the USA's great natural resources, her vastly increased requirements of raw materials cannot be met entirely from national production. Moreover for certain natural products she is entirely dependent on imports.

[2] According to a report in "Newsweek" for 6th November, 1950, the Pentagon is preparing a defence budget for 1952 which will run into $66,000 million : Army $24,000 million, USAF $23,000 million and Navy $19,000 million.

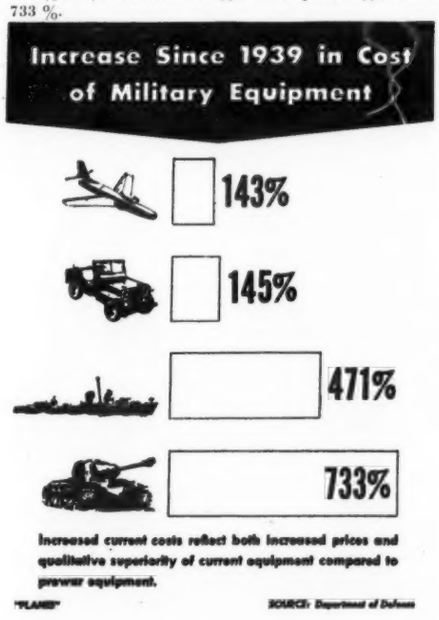
Robert A. Lovett, who helped to build up the American Army and Air Forces during World War II, has been recalled by General Marshall to act as Deputy Defence Minister. His will be the thorny task of co-ordinating defence and other economic demands. An American big business man, he is particularly suited to this task.

Take, for example, natural rubber. According to recent estimates by the *International Rubber Committee* (formed in 1944), the USA will consume a good half of the world production of raw rubber this year, and it is well-known that apart from some small experimental plantations in Northern Brazil she has no rubber trees of her own.

The estimated world production of raw rubber for 1950 (according to the International Rubber Committee) is 1,605,000 tons, made up as follows :

Malaya	685,000 tons
Indonesia	520,000 »
Ceylon	95,000 »
Indo-China	45,000 »
Siam	92,000 »
Borneo	64,000 »
Burma	10,000 »
Liberia	30,000 »
Others	64,000 »
Total	1,605,000 tons

Increases in the price of war material since 1939 : aircraft 143 % ; M/T vehicles 145 % ; warships 471 % ; tanks 733 %.


Increase Since 1939 in Cost of Military Equipment
143%
145%
471%
733%
Increased current costs reflect both increased prices and qualitative superiority of current equipment compared to prewar equipment.
"PLANES"
SOURCE: Department of Defense

Up to the spring of 1950 the Committee thought that this production would be ample to meet world demand. Owing to the events in Korea, however, this optimistic view can no longer be held. On the contrary it is highly improbable that current consumption and the US desire to stock-pile can be met either by purchases of raw rubber or by an increase in her already considerable output of synthetic rubber (425,000 tons).

Admittedly the US position in regard to rubber supplies is especially critical. But even in the case of raw materials of which she is among the foremost producers in the world, American consumption is beginning to exceed production to an alarming degree. (During the first half of 1950 US steel consumption was already 11 million tons greater than during the record year of 1944.)

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What is true of raw materials, applies no less to the *labour market*. Apart from the small core of those workless who can never be absorbed into industry, there is today practically no unemployment. This is true not only of the USA, but also of most of the industrial countries belonging to the North Atlantic Treaty Organisation, particularly of Great Britain. On 1st September, 1950, the Census Bureau (Statistical Office in USA) reported that the number of employed had increased by 1,153,000 during August to an all-time high of 62,367,000 and that there were now only 2,500,000 non-employed in the USA[3]. In other words, even before the supplementary military programme had got under way, there were already 17 ½ million more Americans in employment than in 1939.

And in Great Britain the total unemployment figure at the beginning of July (i.e. before Korea) was no more than 272,000, or 1,3 % of the insured employees. The effect of this dwindling of raw material and labour resources on the aircraft industry was examined in detail in the October number of Interavia Review of World Aviation, 1950. ("What's in the Air ?")

As the age of robot warfare has not yet arrived re-armament requires soldiers, whose recruitment also constitutes a considerable drain on the labour market. Recruiting offices and industry vie with each other in offering attractive conditions.

Early in September the RAF (in common with the Army and the Navy) announced a substantial increase in the pay of NCO's and other ranks. Flying pay was re-introduced, gratuities, and family and uniform allowances for officers were greatly increased. The

[3] By October the number of non-employed had fallen by a further 400,000 to 1,940,000.

The Foreign and Defence Ministers of the Atlantic Powers met in New York in September to discuss plans for mutual defence and an equitable distribution of burdens. Preliminary conversations between (from left to right) Ernest Bevin, Emanuel Shinwell (Great Britain), Robert Schuman, Jules Moch (France), Dean Acheson, General George C. Marshall (USA).

Women's Royal Air Force also had a rise of 75 % in pay. Altogether these increases in pay will cost £68,000,000 a year. The French Air Force has increased its allowance on engagement or re-engagement for a period of five years' service, and trebled the pay for skilled mechanics. And it is scarcely surprising that the example of the RAF has been followed in the rest of the British Commonwealth. On 25th September Mr. Menzies, the Australian Prime Minister, stated that the Royal Australian Air Force had lost too many trained mechanics to industry and that to counteract this tendency, pay in the RAAF would be increased by 20 %.

*

Thus it is scarcely to be wondered at that, when, at this "psychological" moment (October, 1950) the General Staff Committee of the three American armed forces produced a new three-years plan calling for the provision of a further $40,000,000,000 (and an increase in the strength of the USAF up to 90 squadrons), Government and Congress felt bound to repeat the answer given several months ago by Congressman Carl Vinson, Chairman of the Defence Committee : Authorise further expenditure ? Perhaps ... but only if effective controls of prices, wages and raw materials are introduced at the same time.

From the above it is abundantly clear that if the American economy were left to itself in the present conditions of rising boom, it would rapidly race towards uncontrollable inflation.

The transition to a controlled war economy is already in progress ; credit limitations, export restrictions, threatened penalties for hoarding and "grey markets," restrictions on stockpiling of 32 militarily important raw materials (such as steel, certain non-ferrous metals, natural rubber, industrial alcohol, benzole, etc.)—these measures either have already been put into operation or are in preparation. In August the Federal Reserve Board increased the bank rate provisionally from 1½ % to 1¾ % and prophesied additional credit restrictions if this increase should not prove sufficient. The most telling innovation, however, is President Truman's demand that the extra defence expenditure be covered on a "pay-as-you-go" basis, i.e. from current revenue. In other words : *"No expenditure without cover."*

Handicaps

If we have so far appeared to be chiefly preoccupied with the USA, there is good reason for this. So far it has been mainly the Americans who have paid, supplied and suffered, whilst Europe has done little more than work out plans. However it would be quite wrong to misinterpret the state of affairs in the Old World and to reproach it with apathy or unwillingness to make sacrifices, when in reality it is the unhealed scars of World War II that are holding it back. There is no denying that the USA got through the second World War without bomb damage and starvation rations and that she has always been in a position to afford both guns *and* butter. The highest income taxes in the World are still the British [4].

In view of the rises in price of vital raw materials, the new British Chancellor of the Exchequer (Hugh Gaitskell, successor to Sir Stafford Cripps) has introduced quota regulations (in particular for rubber).

On the other hand it is quite understandable that the American Congress is anxious to see action by its European allies, considering that the USA have now contributed Marshall aid, military aid, and Government and private (!) investment for their sister continent for five years.

On 26th July, 1950, the USA sent a memorandum to all the Atlantic Powers asking what special measures they proposed to take to increase the military preparedness of the West. So far the reaction has not been particularly impressive.

True, Great Britain drew up a three-year plan for re-armament, which provides for a total expenditure of £3,400,000,000. At the same time, however, she stated in her reply to the American Memorandum on 3rd August 1950, that :

> "To implement the full three-year programme of £3,400 million would entail very heavy costs in payment of necessary dollar and other imports, loss of exports and reduction of essential home investments. This burden would be so heavy that it would be impossible to carry out the full programme without substantial US assistance in addition to the completion of the European Recovery Programme ... His Majesty's Government do not, therefore, feel able to undertake consistently with the objectives indicated by the US Government, so full a diversion of productive resources to defence purposes unless the USA can offer financial assistance. While a large part of this assistance would, of course, be required to pay for materials, machine tools, components and balancing items from the USA itself, in the circumstances it is essential that the remainder should be dollars which can be used in any part of the world ..."

[4]

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£500	£492	£479
£1,000	£888	£820
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This reply did not altogether meet American wishes : but it was on exactly the same lines as the replies from other European countries.

France decided to draw up an armament programme providing for supplementary expenditure of Fr. 3,500,000,000,000 on defence, i.e. on the modernisation of existing divisions and the creation of 15 new divisions. However, she made the execution of this plan conditional upon the following (Charles R. Hargrove : "France in Face of Re-armament," The Banker, September, 1950) :

a) Reinforcement of the American and British garrisons on the European Continent.
b) Maintenance of a reasonable standard of living.
c) Provision of the major part of the 3,500,000,000,000 by her foreign allies.

The French Government should not be reproved for this attitude of reserve. They have to make allowances for public opinion. And the attitude of the average Frenchman is described by Hargrove in the above-mentioned article (The Banker) as follows :

> "The average citizen here knows well enough that there is nothing to prevent Soviet legions from reaching the Atlantic coast in a week except the atom bomb (which for him is a complete mystery) ; he has, therefore, a lurking fear that a rearmament drive might induce the Russians to bring forward the date of attack unless more Anglo-American troops are quickly dispatched to the Continent."

Moreover, the fact should not be overlooked that the French economy, in spite of the astounding progress it has made, is still in a state of convalescence and in need of careful treatment. The extent to which the French Government can impose fresh burdens is therefore very closely limited by economic, social and party political considerations.

The same applies to a greater or lesser extent to all the European members of the Atlantic Pact.

The *Italian Minister of Defence,* Randolfo Pacciardi, had to call for public support and conduct a veritable press campaign against his colleague, G. Pella, Chancellor of the Exchequer, in order to get a small increase in military credits, which in the budget estimates for 1950-1951 were only half the expenditure for the 1937-1938 financial year. It was only thanks to the intervention of M. L. Dayton, the American Marshal Plan delegate to Italy (who criticised Italy's reluctance to buy industrial equipment while increasing her food purchases) and to a leading article by Antonio Calvi, the editor-in-chief of the semi-official organ of the Italian Ministry of Defence (who warned Italians that reduction in military aid allocations might result), that the way was paved for a three-year plan for 1,200,000 million the fulfilment of Italy's obligations under the North Atlantic Treaty.

Towards the middle of October Pacciardi announced that the Italian Air Force would have six squadrons (Stormi) of North American F-51 "Mustangs" and one squadron of De Havilland "Vampires" by 30th June, 1951— whereupon, on 25th October, he left for Washington to plead for fresh military aid credits.

As a change from this monotonous series of laments, the head of the Budget section of the American Defence Ministry recently received a more pleasing piece of news from Europe. The Belgian estimates for 1950-1951 just published, earmarked no less than 12,572,521,000 Belgian francs [5] for the Belgian defence forces, out of a total expenditure of 80,000 million francs, which represents an increase of over 5,000 million francs over last year.

But otherwise ? Wherever we look we find yawning gaps in national finances. *Denmark,* it is true, spent 358 million Kroner on strengthening her armed forces and a further 300 million on civil defence, but at the same time admitted that a deficit of roughly 800 million Kroner in the balance of payments was to be expected for the coming year. *Holland* complains of a large debit balance in trade, due to her loss of the West German export market, on which the Netherlands economy still depends to a large extent. And the *West German Federal Republic* in turn heaves great sighs over the occupation costs of DM. 4,600,000,000, which also represent a contribution to the common security fund of the Western Powers. Allied circles continue to hold the view that the Federal Republic should pay about 10 % of her revenues into this defence fund, since her internal debts are very much smaller than those of other Western European countries. The USA have pointed out to Germany that she in practice pays only DM. 1,700,000,000 towards the cost of occupation, whereas America pays DM. 12,000,000,000. However, calculations and counter-calculations alike are vain if there's nothing in the kitty.

Exponents of opposing economic principles : American statesman Bernard M. Baruch (left) demands state control of armament production (rationing, price controls, wage freeze), whereas Republican Senator Robert Taft (right) stands for unrestricted economic freedom so as not "to fall victim to the enemy's ideology."

[5] 7,072,521,000 francs ordinary and 5,500,000,000 francs extraordinary expenditure.

What is a fair distribution of burdens ?

This brings us back to our starting point— who is to pay, or better, how much shall each of the members of the North Atlantic Treaty Organisation put towards the common cause ? There has been a surfeit in recent months of statistics showing the arms expenditure of the various countries in percentages of their national incomes (cf. statistics taken from the annual report of the Bank for International Payments, INTERAVIA Review of World Aviation, 1950, No. 8-9, p. 450). Such comparisons of national incomes, however, may be extremely misleading. As the British economic journal, "The Statist" (9th September, 1950) so rightly remarks, two countries with the same national income may be in fundamentally different positions, if in the one case 40 million people live comfortably on this income whilst in the other 400 million people starve.

It would therefore appear to be essential to relate the national income of a country to the size of its population before making it the basis for the contribution to be paid to an international defence fund. The following figures taken from Supplemental Report No. 1265 of the Foreign Affairs Committee of the American House of Representatives serve to illustrate this point. They give the percentage defence contributions of the Atlantic Powers for the year 1948 :

Country	*National income in million* $	*Income per head of population in* $	*Defence expenditure as percentage of income*
USA	224,400	1,530	6.4
Canada	12,800	992	2.0
Great Britain	40,300	806	7.6
France	24,764	592	4.9
Belgium	5,933	698	3.2
Luxembourg	183	610	1.0
Holland	4,826	487	7.7
Italy	9,257	200	6.3
Portugal	1,000	119	4.8
Norway	1,821	552	4.5
Denmark	3,230	769	2.0
Iceland	154	110	0

What is a fair distribution of burdens ? An old question, with which the jurists and theologians, philosophers and statesmen of all ages and in all countries have struggled ever since the days of the Greek philosopher Aristotle, without ever getting any nearer to an answer.

If, contrary to expectations, our own generation should be fortunate enough to find the correct answer to this riddle, there will be no need for armament in either East or West and we shall all be able to turn our thoughts to more peaceful pastimes.

For the man in the street, however, the question remains—who is to pay for all this ?...

Western Air Forces Team Up For Exercise "Emperor"

BY OUR SPECIAL CORRESPONDENT

Exercise "Emperor" ended at dusk on October 15th, 1950. It was the largest air force exercise ever held over Great Britain and, more important, the most elaborate of a series of international military air exercises designed to test the effectiveness of the collaboration between the air forces of the Western World. It was so planned as to give the maximum practice under "active service" conditions to the formations of the Royal Air Force, Anti-Aircraft Command of the British Army, and of the Western Union Air Forces and the Royal Navy. Over 1,000 aircraft were engaged, including both fighters and bombers of the USAF and fighter squadrons of the Belgian, Netherlands, Norwegian and Danish Air Forces. France's *Armée de l'Air* unfortunately was represented only by ground personnel, as it is still in the process of re-organizing in accordance with the lessons learnt from the Western Union air defence Exercise "Cupola" at the end of last August. In particular, the auxiliary units were being exercised to the full during the two week-end phases of the exercise: all the Royal Auxiliary Air Force squadrons, including the plotting and detector units, the aerodrome defence and the Royal Observer Corps —that band of enthusiasts who cheerfully man their network of lonely observation posts across the country.

THE LEADERS' AIMS

The exercise was introduced by a more than usually interesting conference at which the principal commanders each made an address. Since this was primarily a defensive affair—Western Union's accent always being non-aggressive, save when attack is the best form of defence—the main talk was from Air Marshal Sir Basil Embry, the dynamic young Commander-in-Chief of RAF Fighter Command. The points made by Sir Basil were that, above all, "Emperor" was an *exercise* and not a *war game*—that is to say, the primary object was to learn one's own weakness rather than to score off a rival command. That was why the large number of obsolete aeroplanes ("Wellingtons" and "Ansons") were of great importance, since they served the dual purpose of giving experience to trainee crews and of representing mass attacks to test the reporting as well as the operating units of the defence.

General C. F. Loewen, Commander-in-Chief, A.A. Command, pointed out that his men's part in such an exercise must, of necessity, be somewhat passive, since they could not achieve their final end by firing at their target, but had to be content with locating and plotting it. In Great Britain, for economy's sake, the A.A. section of the Army is on a reserve basis, with but a small core of regular personnel and National Service men. This means that in such an exercise everything depends upon the enthusiasm and *morale* of men who after a day's civilian work spend their nights at their posts—and their keenness was much in evidence throughout the exercise.

Senior officers in charge of "Emperor" *(left to right)*: Major-General Leon W. Johnson, Commanding General USAF Third Air Division, based in Britain; General C. F. Loewen, General Officer Commanding-in-Chief, Anti-Aircraft Command, British Army; Air Marshal Sir Basil Embry, Air Officer Commanding-in-Chief, Fighter Command, RAF; and Air Marshal Sir Hugh P. Lloyd, Air Officer Commanding-in-Chief, Bomber Command, RAF.

Air Marshal Sir Hugh P. Lloyd, as the "enemy," again emphasised that "Emperor" was intended to give practice and was not a competition—yet throughout the actual operations rivalry between the commands was intense and it was not easy to get any advance information of the enemy's intentions, even to the exclusion of press representatives from the briefing of the bomber crews with whom they had been detailed to fly. Night operations were undertaken by RAF Lincolns, Mosquitos, and Washingtons (B-29s) and Wellington trainers, while by day the USAF operated B-50s and the RAF used Flying Training Command aircraft and Vampires to represent the jet bombers still so sadly lacking.

The USAF 3rd Air Division ran with the hare and hunted with the hounds, for it provided F-84 Thunderjets for the defence and also B-50 Superfortresses with F-84 escorts for the attack; an invidious position for an officer with less tact than Major General Leon W. Johnson! The latter, in his short address, responded to Air Marshal Lloyd's reference to "our Washingtons, named after the old English family" by asking in what country lived the Lincoln family! *

To sum up: The principal objects of Emperor were to test the whole elaborately integrated network of observation, reporting and active defence by land, sea and air necessary for the protection of the whole of England and Wales as far North as the Scottish Borderlands and to give a practical workout to every member from the C-in-C downward. Defences, in general and in detail, were to be intensively exercised by high and low level attack by night and by day. The bombers were given practice as an incidental to providing the defences with their targets; but although their presence was essential, the training value to bomber crews was the key rather than the actual testing of methods of attack.

This may seem a long preamble, but it does set the scene for the actual exercise, which did in fact follow closely on the prescribed lines. Every effort was made to obtain realism, many units were under canvas or were operating as "lodgers" at strange aerodromes, guards were posted and passes were examined as in wartime and, as I said before, careless talk was discouraged so that neither side could make too close a guess at the other's intentions—although, with most bombers leaving home bases, it is obvious

Western air defence cooperation: A Danish Gloster "Meteor" being refuelled by a new type of Dutch tanker at a British airfield. The tanker has three outlets and is capable of refuelling the "Meteor" in three minutes, compared with 15 minutes of the normal RAF refuellers.

* The Boeing B-29 "Washington" and Avro "Lincoln" (as was the Vickers "Wellington") were of course named after the *places* and not the *men*, as is the custom for all RAF bombers.

that the "plots" of outgoing aircraft must have revealed the approximate strength of the ensuing attack.

It takes the Scientific Research Branch of Fighter Command three months to assess the results of such an exercise as "Emperor," so it would be rather presumptuous for me to sum it up. In any case, having discussed it with several who followed each of the three phases (noon, October 7th, to dawn, October 9th; dawn, October 10th, to dawn, October 13th; noon, October 14th, to dusk, October 15th) I find that, according to whether they watched with the defence or the attack their impressions of the interception rate vary! It certainly was not the hundred per cent that must be approached to give protection from an atomic attack, but Sir Basil Embry has stated that it was considerably better than during the War. This, coupled with Sir Basil's obvious enthusiasm and alert mind, indicates that he will make any changes, however drastic, that might be needed to improve efficiency as indeed he did after the previous exercises.

An RAF D. H. "Hornet" long-range escort fighter at West Malling RAF Station, Kent.

THE EQUIPMENT POSITION

New radar and armament equipment exists, and new methods were being employed in "Emperor"; but it is obvious that these cannot be mentioned. New RAF aircraft were scarce, not because of any backwardness in technical development, but through severe shortage of money and men. In part, this was due to the natural limitations of the British population

Jet fighter pilots being briefed before take-off.

both in numbers and in materials after a long war; in part also to Britain's desire to disarm after 1945, now regretfully overruled by circumstance; and also to quite a large extent to the dissipation of effort and of cash and material resources in the furtherance of the political policies of Britain's present Government.

The jet bomber had still to be represented by the Vampire, because the Canberra, excellent as it is, cannot be in squadron service before next year. The Mosquito, now nine years old, is still an effective night bomber, but is too slow for daylight operation against jet fighters. In the heavy sphere the position is even

The "skipper" (Flight-Lieutenant Dacre) inspects his crew and equipment at Marham RAF Bomber Command Station, Norfolk. Their aircraft is a "Washington" bomber—a rechristened Boeing B-29 "Superfortress" of the USAF now in service with the RAF.

worse, with only the Lincoln and the Washington—and not even a prototype heavy jet bomber in the air. Considering Britain's limited size, the Ministry of Supply and Air Ministry were undoubtedly right in not rushing ahead with a programme of jet bomber prototypes until the jet engine had been developed to a real state of practicability; but now the delay in the appearance of large jet bomber prototypes is alarming when one considers the time lag inevitable before the arrival in quantity of any complicated modern aeroplane.

The jet fighter position is much better. Although the Meteor and Vampire are wartime designs, their performance is up to that of most jet aircraft in service when it comes to practical application, because of the advantage in manoeuvrability which they gain from their low wing loading. They are also admirably integrated; for the Meteor is a very steady gun platform and has the ceiling and climb, while the Vampire has unmatched low-level manoeuvrability. The F-84, although very fast, lacks combat manoeuvrability at altitude. The Meteor 8 was in service for the first time and represents a considerable operational advance on the Mark 4. There is also room still, as was proved in Korea and further exemplified in "Emperor," for

Norwegian participation in "Emperor": Lieutenant Ebbeson, from Oslo, jumps from the cockpit of his "Vampire" at North Weald RAF Station, Essex, after being out on a sortie over the South of England.

low-level piston-engined fighters of moderate wing loading, like the Spitfire.

Night fighters were still the old Mosquito which, although fast enough to intercept the Lincoln and B-29 or B-50, would have been useless against a jet bomber. The Meteor NF 11, if it arrives soon, should overcome this situation as, with its excellent stability at all speeds, it will be a very good radar and gun platform. The Venom NF 2 is another good night fighter still "on the way."

WESTERN UNION PARTICIPANTS

The inclusion of Squadrons of Meteors, Vampires and Mosquitos from the Belgian, Danish, Netherlands and Norwegian Air Forces was not, as might be imagined, intended as a reinforcement to Fighter Command. The purpose was the dual one of giving the personnel practice under active service conditions while operating away from base and in fighter control and interception, and at the same time of gaining

Boeing "Washington" bombers on dispersal hard standings at Marham airfield.

further experience in the international co-operation necessary to Western Defence. Operating under the direction of Fighter Command, these squadrons (at North Weald, near London, and Horsham St. Faith, near Cambridge, in the main) gave an excellent account of themselves and, if the sad conditions of 1940 had been repeated, would have proved a valuable addition to the strength of the Royal Air Force. The principal difficulty, that of language, becomes less of a problem with each of these exercises and with the frequent trips by units between the countries of Western Union.

So much for the major participants and their virtues or shortcomings. The operations themselves can be broken down into the following principal forms.

THE OPERATIONAL PICTURE

In daylight the Boeings of the 3rd Air Division made attacks at heights of around 25,000 feet and were escorted by F-84s. They were largely intercepted by Meteors and Vampires well out to sea. Escorted Mosquitos from BAFO (British Air Forces of Occupation) in Germany made other mass attacks at between 20,000 and 25,000 feet. At 30,000 feet and above the Vampire pseudo-bombers came in from Germany to raid such distant (from their bases) targets as Yeovil, Nottingham and Poole (Dorset). Low-level attacks on aerodromes and convoys and photographic reconnaissance flights were made by Spitfires, Mosquitos and Hornets. In all these daylight operations interception, both by "scrambles" and by standing patrols, under radar ground direction was effective.

It is worth noting here that the Royal Navy was closely integrated with the operating Air Forces. Ships were supplied to act as convoys, both in the Channel and the North Sea, and the guns of those

An armed guard on a Boeing B-50 "Superfortress" bomber (development of the B-29) of the USAF Third Air Division at Marham.

Night operations consisted of individual, stream and mass attacks, together with extensive intruder operations against airfields. To simulate actual conditions to the full the bombers, after taking off from their British bases, made long flights of six hours or so out to sea before coming in to "attack" their targets. Thus, each bomber gave practice to the whole defence chain. The bombers then went on to drop practice bombs on a range so that the crew's performance after a long flight could be assessed. Raids on simulated pathfinder flares and with the control of master bombers were made in the manner of Air Marshal Harris' attacks on Germany.

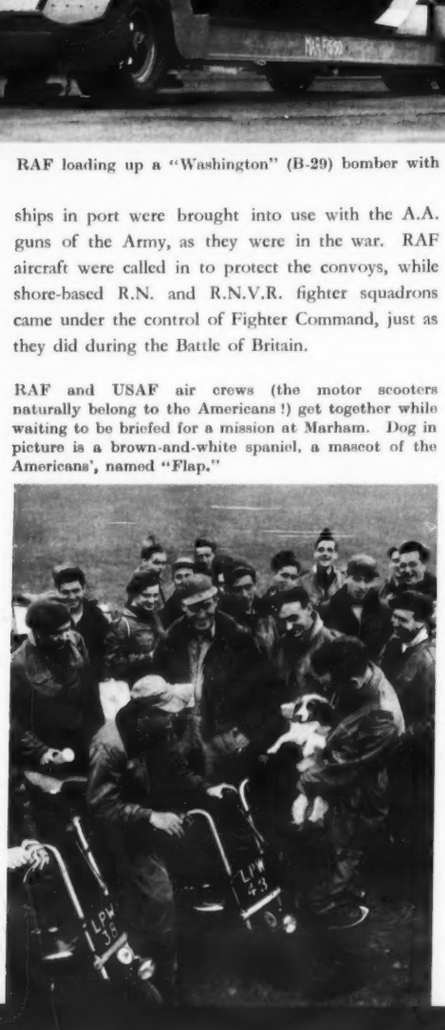
On one night (October 12th-13th) a mass raid was carried out by Lincolns and Washingtons on the bombing range at Larkhill, Salisbury Plain. This was made in force after a rendez-vous over the Irish Sea, and practice bombs were dropped on target indications laid by "Mosquitos."

Map of the "Emperor" flight made by our Correspondent aboard a Boeing "Washington" bomber (B-29 "Superfortress") of the RAF bold line). Double-headed arrows (thin lines) show that bombers mostly had two objectives.

RAF loading up a "Washington" (B-29) bomber with 4,000-lb. bombs at Marham.

ships in port were brought into use with the A.A. guns of the Army, as they were in the war. RAF aircraft were called in to protect the convoys, while shore-based R.N. and R.N.V.R. fighter squadrons came under the control of Fighter Command, just as they did during the Battle of Britain.

RAF and USAF air crews (the motor scooters naturally belong to the Americans!) get together while waiting to be briefed for a mission at Marham. Dog in picture is a brown-and-white spaniel, a mascot of the Americans', named "Flap."



As I said earlier, the *results* of such an exercise take many weeks to analyse and individual experiences can lead to most misleading opinions. What does seem clear is that Emperor went more smoothly than any previous exercise, both in the matter of actual flying and in all the supporting fields—not the least of which was the exceptional degree of aircraft serviceability.

The authorities have been particularly reticent about night interception results, but one imagines that this gives the greatest field for improvement. The sky over even so small a country as England is a very large volume when it is being attacked from ground level to 25,000 feet.

A TYPICAL NIGHT RAID

If I may end on a personal note, perhaps a few points about a flight as supernumerary in one of the RAF Washingtons from Marham RAF Station may be of interest. The B-29 was, of course, designed as a day-bomber, but the RAF is using it as an interim night-bomber pending the arrival of a Lincoln replacement. Therefore, although it is fully equipped with U.V. lighting and night sights, etc., it is not ideal for its work. In particular, the long, rounded, glazed nose produces distracting reflections from many of the instrument lights. The fuselage, which looks so plump, is surprisingly cramped because of the large bomb bays and the intrusion of the gun barbettes. On the other hand, the aeroplane is quieter than most air liners—the pilot's station is about equivalent to the *best* seats in a "Constellation"—and the pressurizing and heating are excellent. My trip lasted nine hours, alternating between the comfortable bombing seat in the nose and the floor beside the flight engineer, yet I did not find it as fatiguing as a night train journey—and it was very much smoother.

Taking off after dusk we flew at 3,000 feet out to the Dutch coast, through a turbulent front that piled ice on our aerials and required constant use of airframe and propeller heating, and then turned north to Norway, where we pressurized before climbing to 20,000 feet and turning towards the North of England. Crossing the coast near Middlesborough we flew, without lights, west to the Irish Sea, turned South across Wales and "bombed" an airfield near Stratford-on-Avon. Thereafter we continued east over Holland and Germany before turning to make an attack on Sheffield, returning to Marham shortly before dawn.

During this nine hour flight the crew was constantly exercised; the navigator and the radar and radio operators were working on the complicated dog-leg courses with the purpose of arriving over the target "on schedule" (bombs were "dropped" within one minute after five hours flying) and the flight engineer was controlling his speeds and r.p.m. to keep to the range plan. Trouble with "George" (the automatic pilot) made it necessary for the two pilots to take turns in manual flying from take-off to landing. The air gunners, in their monotonous task, were on the lookout throughout the flight for the many fighters that were about. To end the night, although the weather was clear, a practice GCA approach was made by the captain.

This crew had not long converted to the Washington and I was much impressed by the confident way in which they handled a complicated aeroplane. As an example, the pilot's and flight engineer's checks are sufficiently lengthy to occupy, each, a closely typewritten page.

The Air Hostess Told Us...

REGULATED COMPETITION...

Competition, Esmeralda stoutly maintains, is the lifeblood of something or other. It is one of the things that make the world go round (mostly like a merry-go-round). You, for instance, our Favourite Air Hostess said to the Editor, you couldn't hold your job down for two minutes if you didn't do your stuff: the Assistant Editor has that lean and hungry look in his eyes. And you, the Editor replied, would stand even less of a chance, because twenty thousand pretty girls are simply mad keen on taking your place. Quite, said Esmeralda modestly, but I'm irreplaceable. The passengers wouldn't like it.

The result of competition is, of course, that the tougher chap usually wins. In other words, he cuts his rival's throat, eats him up, railroads him out of town. And in most cases toughness isn't enough. If two chaps are equally tough, it's the one who is tough *and* as crooked as a drunken snake that gets the better of the other. Sometimes neither gets the better of the other. They just claw each other to death.

Mostly there is *somebody* who benefits by competition. If the competitors are selling candy, they cut their prices and the kids get their bad teeth quicker and cheaper. So it's the dentist who benefits. If one competitor is knocked out quick, it's the other who puts up his own prices, and the kids benefit by fewer toothaches. And if both go out of business, everybody is depressed, kids, dentists and all.

In the airline business, Esmeralda explains, there must be competition. It's good for the passengers. They get better service and more food aboard. But there mustn't be too much of it, otherwise the operators will cut each other's throats and in the end there will be no airlines left, except perhaps a single one with such high fares that finally it commits hara-kiri. For that reason "regulated competition" has been introduced in air transportation. Which means that you *can* compete with your competitors, but you really *can't*, if you see what I mean. You don't get very cheap fares, but you get more than you can use of everything else. Regulated competition is wonderful. You can buy thousands of cheap cigarettes free of excise duty aboard an airliner and think about how much you'd like to smoke them after the customs have thrown you into the local jail for evading customs duty.

It is on this principle that regulated competition is now being waged on the Paris—London service. The process will go down in history as The Battle of the Booze. The fare charged for the run is naturally fixed by international agreement, as a result of which the welcome manifestations of competition are revealed only in the etceteras, notably alcoholic drink. Several weeks ago Air France began serving a six-course meal to passengers, free of charge, complete with a cocktail and a small bottle of champagne. British European Airways has now reduced the price of its drinks, already inexpensive since they are not subject to excise duty. Champagne sells for 3s. 6d. (about 60 cents) a quarter-bottle, a double brandy is 2s. 6d. (35 cents), and a glass of vermouth is only a shilling (14 cents). The prices for extra drinks on Air France aircraft are slightly higher, but the French company is expected to reduce them in the near future—to the chagrin of BEA and the delight of the travelling public. The foreseeable result will be that in this particular case it will not be the competitors who will be rendered groggy by unbridled competition, but the beneficiaries of the fight. Just think of the time, says Esmeralda, when alcohol and nicotine were taboo on commercial airlines.

...AND REGULATION OF COMPETITION

As you see, our Favourite Air Hostess points out, competition can be quite funny. But, she says, the actual regulating of the competition can be equally mirth-producing. There was the famous case of Pan American Airways' plan to buy up American Overseas Airlines. The case was argued before the US regulating authority, the Civil Aeronautics Board. For about eighteen months the CAB listened, cited witnesses, took notes and considered the matter from so many angles that its learned members ended up with about sixteen different kinds of kink in their ponderous necks. Finally they came to a decision, last summer: no, they said, no merger, it's not in the public interest. They took their decision to the President of the USA, who has the final say in such matters. Truman took one look and said, but of course there will be a merger, it's in the best public interest! Whereupon the CAB "reversed" itself (in official argot: it probably means that the CAB members stood on their heads) and "Decided" that their previous decision, which they had taken 18 months to make, was just a joke and the opposite was true.

Esmeralda says this reminds her of a story. A young man in Washington was feeling very ill and was an absolute nervous wreck. His doctor told him—listen, my boy, you come off the liquor and the Havana cigars, leave the city and take a nice, long rest on a farm. In about three months you will be all right.

Our friend went off and sat around on this farm for weeks. He was getting visibly fatter—and more nervous. One day he told the farmer: look, I am going haywire in this place, sitting around all day doing nothing. If you don't give me something to do tomorrow, I'll jump in the river.

Next morning the farmer took him into the yard, handed him a pitchfork and said: see that huge heap of manure over there? Spread it evenly over that ten-acre field—take your time, two weeks will be soon enough. Two hours later he found his man sitting in the yard, sadly toying with his pitchfork. The manure was gone, it was nicely distributed over half the county. Give me something else to do, said the man.

Flabbergasted, the farmer took him to an enormous barn, in one corner of which were piled about sixty-seven tons of potatoes. Here you are, he said, you sort out these spuds. Two heaps—little ones on the left, big ones on the right. The way you work you ought to get through this heap in about two hours.

Six hours later the farmer walked over to the barn to see why the fellow hadn't turned up for dinner. He found him sitting on a log, in front of the untouched pile of potatoes. Wearing a frightfully worried frown, he was disconsolately tossing a solitary potato from one hand to the other. What the *** have you been doing all this time? exploded the farmer. I'm sorry, the young man said, not to have done any work. You see, I worked for the Civil Aeronautics Board back in Washington, and I simply can't make a decision.

C.G. Grey's 75th Birthday

Without th Wright brothers, Lilienthal, the Farman brothers and all the other pioneers, aviation would not be what it is today. Without the aircraft and engine constructors of various countries the whole thing would never have got beyond the early stages.

What of the part played by the writers and journalists, those enthusiasts who attracted the crowds to the first airfields forty years ago, awoke governments and military to the future possibilities of flying, and kept up courage and public confidence after accidents, failures and other difficulties.

Today we pay homage to a veteran among aviation journalists, to *Charles Grey Grey,* whose signature "C.G.G." has been a watchword for forty years, and who celebrated his 75th birthday on 13th November.

C.G.G. has been one of the stoutest supporters, but at the same time one of the most unbending of critics of pre-war aviation, especially the British. Many people think he is Irish, but he has not a drop of Irish blood in his veins.

Born in London in 1875, he comes of an English family which has held land in the County of Northumberland since 1104. In 1880 his father was sent on an official mission to Ireland, and C.G.G. went to school in Dublin until 1893.

He then went to London to the Crystal Palace School of Practical Engineering, which later produced other outstanding men of the aviation world, such as Geoffrey de Havilland.

Grey began as a bicycle mechanic, worked in the electrical and automobile industry and later became a technical instructor.

In 1905 he joined the publishing house of Iliffe & Son Ltd., publishers of "*The Autocar,*" who sent him to report the first Paris Aero Show in 1908. This decided Grey's career. In 1909 he founded "*The Aero*" and in 1911, in partnership with Sir Victor Sassoon, "*The Aeroplane.*"

Up to 1939 "*The Aeroplane*" remained C.G.G.'s exclusive province. Every week, rain or fine, he wrote his leading article. When he read it through later his own hair sometimes stood on end. He had never been able to master his thoroughly un-English temperament, but had always uncompromisingly expressed his own convictions.

Grey has not forgotten how to write since 1939. From time to time he has even written for INTER-AVIA. Today he is air correspondent of Provincial Newspapers Ltd., for whose papers he writes a weekly article.

From 1915 to 1941 he edited the classic year-book, Jane's "All the World's Aircraft," proof that in spite of his exuberance he has solid technical knowledge and judgment.

We wish this good friend many more years of unbridled activity.

The Flying 'Roo

QANTAS 1920—1950

It was 5.30 a.m. on 3rd November, 1922. With all the agility he could muster, 85-year-old Alexander Kennedy clambered into the waiting aeroplane to fly from Charleville to Cloncurry in Eastern Australia. His feelings as he sat there, watching the landscape slip away below him, can well be imagined. He had crossed this same country before, 53 years earlier. But that had been a different story. His conveyance then had been a bullock-cart and the journey had taken him a full eight months. And here he was now setting off to cover those 577 miles in two days in the new-fangled contraption, the aeroplane! The passing years had not dimmed his fine old pioneering spirit. Was he not the very first passenger to fly on the new QANTAS air service opened the day before?

A big dose of this same pioneering spirit had been necessary before even such an apparently modest service (by modern standards) could be organised, and much more was to be needed in the coming years to increase QANTAS operations from these humble beginnings to their present network covering 33,000 route miles.

Back in 1919, in those days when flying had all the romantic attraction of a venture into the unknown, the Australian Government offered a prize for the first crew to complete a flight from England to Australia within 30 days. In this connection ex-Australian Flying Corps Lieutenants W. Hudson Fysh and P. J. McGinnis were commissioned to make a ground survey of the air route between Longreach, in Queensland, and Darwin. On this journey, mostly made by Model-T Ford, Fysh and McGinnis soon realised what a boon an air service would be to this desolate country where ground transport was almost non-existent. A chance encounter with a wealthy sheep farmer, Fergus McMaster (subsequently Sir Fergus)—McGinnis helped him pull his car out of a sandy river bed one Sunday afternoon—set the ball rolling. McMaster had the precious gift of recognising a good idea when he saw it and the energy and enthusiasm to interest others in it. Within a few months enough capital had been got together to form a company.

So the *Queensland and Northern Territory Aerial Services, Ltd.*, was registered on 16th November, 1920. This title was soon abbreviated to QANTAS, a name which has stuck throughout the years.

For two years the new company confined itself to general air-taxi work and joy-rides, with the idea of demonstrating the advantages of air travel to the inhabitants of the "outback." Early taxi-trips included the carriage of the first maternity case to go to hospital by air in Australia and the first Australian aerial turkey-shoot...

Difficulties, both technical and financial, were great. The Company's two aircraft were converted World War I machines, a B.E. 2 E and an Avro 504, both of which were designed originally for vastly different purposes and climatic conditions. There were no experienced mechanics apart from W.A. Baird, the engineer. Pilots (i.e., Fysh and McGinnis who with Baird constituted the whole of the staff) had to do their own repairs and overhauls, very often with makeshift equipment. Moreover, joy-rides and other odd jobs were far from profitable.

Nevertheless, the shareholders never lost their faith in the undertaking, and fresh capital was always forthcoming when required. Finally a Government subsidy was obtained for the inauguration of a regular mail and passenger service from Charleville to Cloncurry, with a night stop at Longreach. This was opened on 2nd November, 1922, with a "fleet" of two Armstrong-Whitworth war-type biplanes.

Although a converted de Havilland 4 with a closed cockpit for two passengers had been added to the fleet early in 1923, progress was slow until the arrival in 1924 of the first real passenger aircraft to reach Australia, the de Havilland DH-50, which provided comfortable accommodation for four passengers. This machine proved extremely successful and gave the first real impetus to commercial flying in Australia. It was in this machine that the then Prime Minister (now Viscount Bruce) flew during his 1924 electioneering tour, the first time a Prime Minister had flown within the Commonwealth. If the Prime Minister could fly, why not Mr. Smith or Mr. Jones?

Gradually Mr. Smith and Mr. Jones, not to mention Mrs. Smith and Mrs. Jones, did in fact become more and more air-minded,

Hudson Fysh

Now 55 years old, Hudson Fysh has been the moving spirit of QANTAS throughout its life. It was Fysh who, with McGinnis, first conceived the idea of air services in the Australian "outback" and persuaded Fergus McMaster and other wealthy sheepfarmers to put up the money for a Company. He had been a pilot in the Australian Flying Corps during World War I, and he and McGinnis were the first two pilots in QANTAS Ltd. Both were responsible for many a pioneering flight. Fysh was made Managing Director in 1923 but continued active flying until the Company moved its headquarters to Brisbane in 1930. Later he toured Europe and America to study civil aviation in those continents, and he did much valuable survey work for the England—Australia route. During World War II his main effort was directed towards ensuring that QEA played its full part in the Australian war effort.

Today he is Chairman (in succession to Sir Fergus McMaster who was forced by ill health to retire in 1946) and Managing Director of QANTAS Empire Airways, a member of the Board of Directors of Tasman Empire Airways and a member of the Executive Committee of the International Air Transport Association, in which latter capacity he has played an active part in the reshaping of international air transport.

QEA LEADING LIGHTS

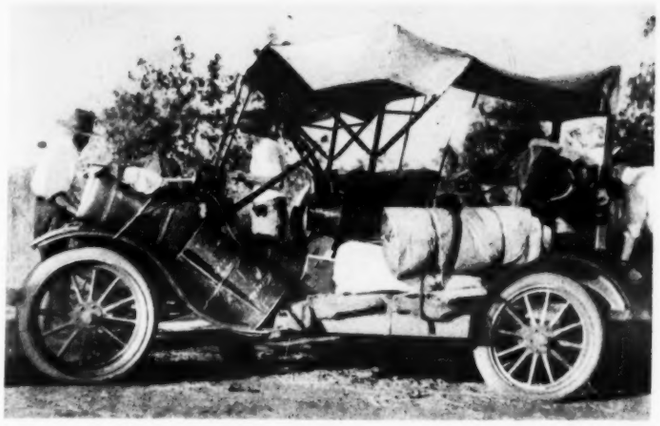
Sir Fergus McMaster, one of the founders of QANTAS Ltd. and Chairman up to 1946

H. H. Harman, General Manager

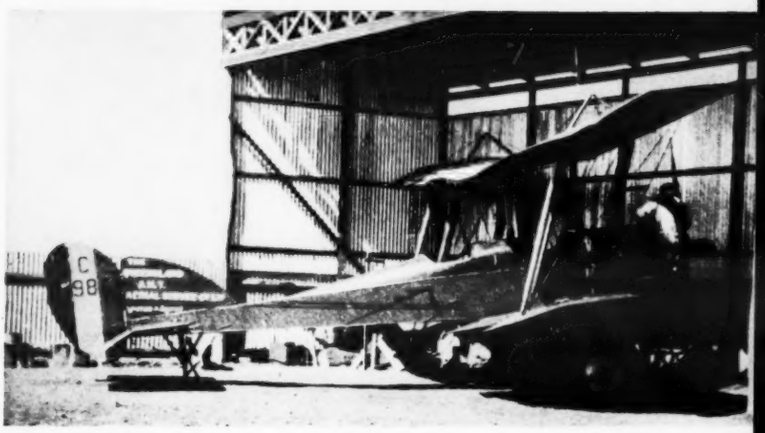
W. H. Wright, Chief Engineer

Captain W. H. Crowther, Operations Manager

C. W. Nielson, Traffic Manager



In a Model-T Ford Lieutenants Hudson Fysh and McGinnis surveyed the Australian portion of the route for the first England—Australia flight in 1919.



One of QANTAS' first two aircraft, the B.E. 2 E, in the Company's first hangar, 1921.

and as the years went by, each marked by some innovation or improvement in comfort or safety, QANTAS's services expanded. Route mileage in 1922 had been 577 miles. By 1930 it was 1,484 miles, and the total aircraft mileage had reached the million mark. Still not remarkable by today's standards. But what sweat and toil this expansion had cost...

Meanwhile the Company had been continuing its pioneering efforts in a variety of directions. The year 1925 saw the first successful ground-to-air radio experiments to be made in Queensland, 1926 the opening by QANTAS of the Longreach Flying School, to be followed the next year by the Brisbane Flying School, where the first organised flying training in Queensland was undertaken.

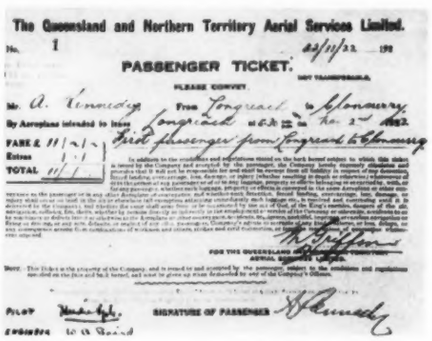
Another pioneering venture followed in 1928. This was the Flying Doctor Service, the first in the world. Although maintained by the Australian Inland Mission, it used QANTAS aircraft and crews and owed much of its early success to the Company's efforts.

The first real stepping-stone to QANTAS's present position in world aviation came in 1931, when the Company helped in carrying the first experimental official air mails between Australia and England, in cooperation with Imperial Airways. One of their earliest aims had been the establishment of an air link between Darwin and Brisbane, and it was this section of the new route that was allotted to them. This contact with Imperial Airways led to the formation, in 1934, of QANTAS Empire Airways, a new Company combining the interests of QANTAS Ltd. and Imperial Airways as far as the operation of the Australia—England service was concerned. This service was opened as a regular passenger and mail link on 10th December, 1934.

Thus ended the first phase of QANTAS operations.

Setting off on the first experimental mail flight from Australia to England, 1931. QANTAS flew the Brisbane—Darwin section of the route. The aircraft was a De Havilland DH-61.

What of the air fleet during these years of experiment and growth? Up to 1926 no really satisfactory aircraft types had been available. Even the English types produced after the War had not been altogether suitable for operations in the Australian bush, where the temperature was frequently 114° F. in the shade, or along the coast, where humidity was so great that plywood covers peeled off. So in 1926 QANTAS acquired a licence from



The Queensland and Northern Territory Aerial Services Limited.

No. 1 22/11/22 19

PASSENGER TICKET.

PLEASE CONVEY

Mr. A. Kennedy From Longreach to Glenormiston

By Aeroplane intended to leave Longreach at 6.0 a.m. on the 24 day of Nov. 1922.

FARE £ 11 | 2 | -

Extras | - | -

TOTAL 11 | - | -

First passenger from Longreach to Glenormiston

In addition to the conditions and stipulations stated on the back hereof subject to which this ticket is issued by the Company and accepted by the passenger, the Company hereby expressly stipulates and provides that it shall not be responsible for and shall be exempt from all liability in respect of any damage, loss, delay, or injury (whether resulting in death or otherwise) whatsoever or howsoever caused to the passenger or to any other person or property or effects conveyed in the same Aeroplane or otherwise carried for any purpose whatsoever upon

Two of the Short "Empire" flying boats which revolutionised air travel on the England—Australia route. Put into service in 1938, they offered passengers modern standards of comfort.

was Sydney and the service was operated three times a week.

It seemed as if the pioneering age was over. There would of course be bigger and faster aircraft, improved navigating instruments, new services opened and so on, but in all probability nothing very *new*. Things seemed to have settled down into a comfortable state where nothing very startling happens. After all, aviation was beginning to get "middle-aged"!

*

However, September, 1939, was approaching, and with it a decade of rapid aeronautical development.

The first impact of the war on QEA was the call-up, within a month of the outbreak of hostilities, of the first crews to the Royal Australian Air Force. Gradually virtually all the resources of QEA were devoted to the war effort, the Company earning the highest praise for its contribution towards the maintenance of essential services right up to the end of the war.

Early in 1940, QEA became partners in a new enterprise, Tasman Empire Airways, which was set up to operate services across the Tasman Sea from Sydney to Auckland.

The fall of France and the entry of Italy into the war brought the first interruption to the Australia—England service. Immediately a new service, later known as the "Horseshoe Route," was planned. This was Sydney—Durban—Sydney via India and Cairo and was operated with great success until it, too, was broken by the Japanese capture of Malaya and Singapore in 1942.

Meanwhile, a new task had been set some of QEA's crews. The RAAF had ordered a batch of "*Catalina*" flying boats from Consolidated Vultee Aircraft Corp., San Diego, California. American was not yet at war, and it was felt better that delivery of these aircraft should be taken by a civilian organisation. Moreover only QEA crews had the necessary experience for such long-distance operation. Consequently QEA crews it was who flew the "Catalinas" from Honolulu to Sydney, over a route which had previously been flown only twice. In all, 19 of these flying boats were ferried to Australia without incident.

The Japanese capture of Malaya and the East Indies during the winter of 1941-42

A "Catalina" on the wartime Kangaroo service across the Indian Ocean in 1943. The aircraft made the 3,500-mile hop from Perth to Ceylon in 28 hours.

A QEA De Havilland DH-84 "Dragon" at an airfield in New Guinea, 1948.

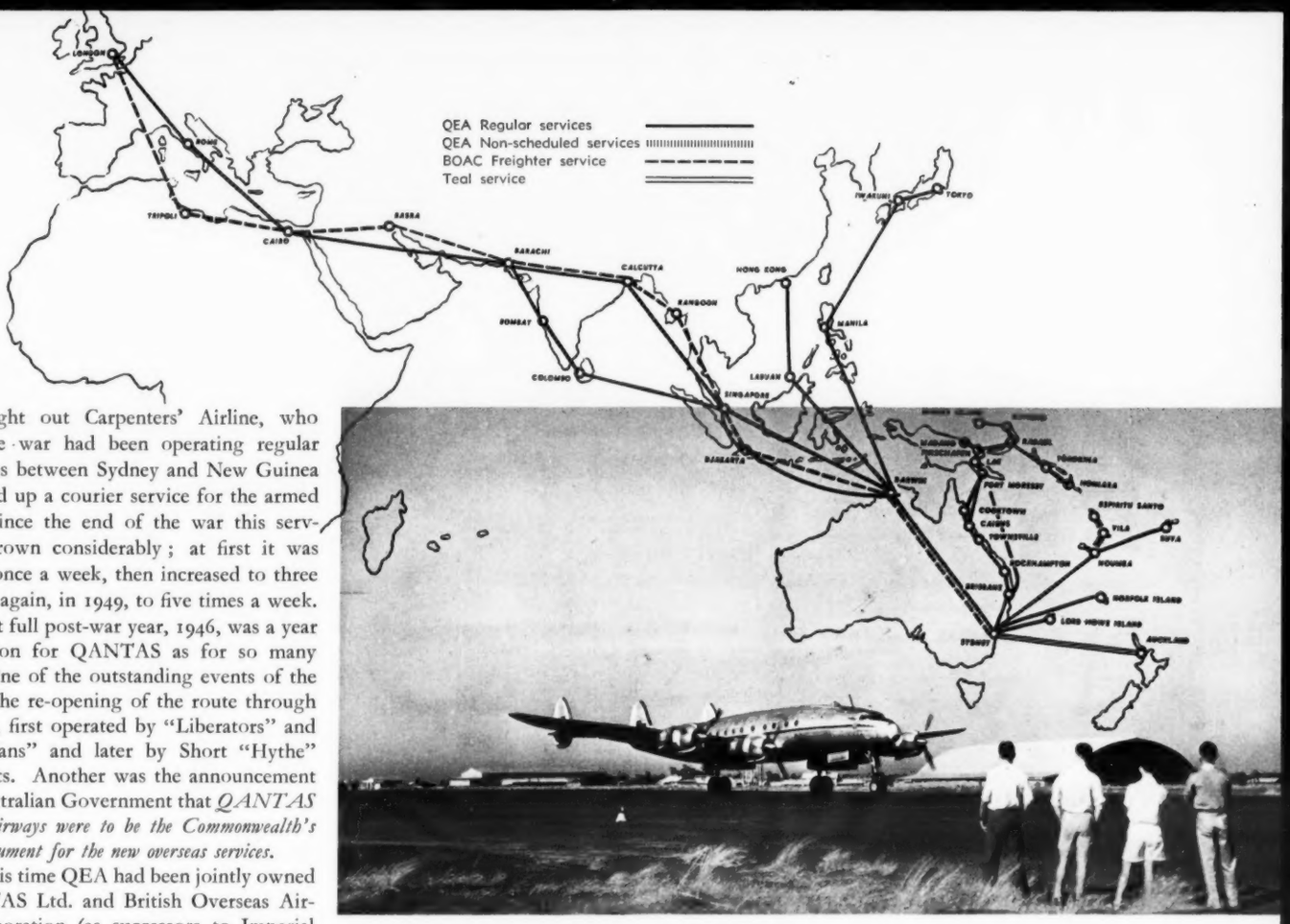
once more cut the Australia—England service most effectively. Immediately QEA determined to re-establish this valuable link, and on 10th July, 1943, they inaugurated their "emergency route" from Perth to Ceylon with "Catalinas," which covered the 3,500-mile stretch non-stop in an average of 28 hours. This service linked the South West Pacific Area and South East Area Command and was used solely for the carriage of diplomatic mail and VIPs. Yet another pioneering achievement, rendered all the more remarkable by the fact that except for a brief period after take-off and before landing, complete radio silence had to be maintained, as it was obvious that nobody wanted to meet the Japanese en route. Moreover, maps and charts of the Indian Ocean were at that time none too adequate. So that all in all this new service demanded superb navigation and an unusual wealth of flying experience.

Later the "Catalinas" were replaced by faster Consolidated B-24 "Liberators" and Avro "Lancastrians," which reduced the crossing to 17 hours. Because of the long hop across the Indian Ocean—the longest air hop in the world, this service became known as the "Kangaroo Service." Altogether 824 flights were made across the Indian Ocean.

*

Another scene of QEA operations during the war was New Guinea. — At first the Company's aircraft were used to evacuate civilians, and later, during the height of the campaign, Empire flying boats carried troops and equipment to battle stations and brought back wounded to Australia. Early in 1945

QEA's hangars at Kingsford Smith Airport, Sydney. Aircraft on the ground: Consolidated B-24 "Liberator," Avro "Lancastrians," Lockheed "Constellation," Douglas DC-3s and DC-4.



A "Constellation" arriving at Darwin from London, 1950.

they bought out Carpenters' Airline, who before the war had been operating regular air services between Sydney and New Guinea and started up a courier service for the armed forces. Since the end of the war this service has grown considerably; at first it was operated once a week, then increased to three times and again, in 1949, to five times a week.

The first full post-war year, 1946, was a year of transition for QANTAS as for so many others. One of the outstanding events of the year was the re-opening of the route through Singapore, first operated by "Liberators" and "Lancastrians" and later by Short "Hythe" flying boats. Another was the announcement by the Australian Government that *QANTAS Empire Airways were to be the Commonwealth's chosen instrument for the new overseas services.*

Up to this time QEA had been jointly owned by QANTAS Ltd. and British Overseas Airways Corporation (as successors to Imperial Airways). During 1947, however, the Company passed entirely into Commonwealth hands, the BOAC shares being bought out in March and the QANTAS in July.

From now on, progress was by leaps and bounds. Four Lockheed "Constellations" were bought from USA and put into service on the Australia-England service, which QEA were by now operating all the way through to London (total distance 12,100 miles). "Lancastrians," stripped of their seating and other passenger equipment, were carrying mails between Sydney and Karachi, and "Hythe" flying boats between Sydney and Singapore. The same year saw the transfer to QEA of the RAAF courier service between Sydney and Japan. Operated initially on a purely military basis, it now also carries civilian passengers, in Douglas DC-4s.

Other services have followed, so that QEA now have the following lines in regular operation (the inland services were handed over in April, 1949, to Trans Australia Airways):

1) "Kangaroo": London-Sydney, with "Constellations."
2) "Bird of Paradise": Sydney-New Guinea, with Douglas DC-3s and DC-4s.
3) Sydney-Hongkong, with Douglas DC-4s.
4) Sydney-Japan, with Douglas DC-4s.
5) Sydney-Noumea-Suva, with Short "Sandringham" flying boats.
6) Sydney-Norfolk Island, with Douglas DC-4s.
7) Sydney-Lord Howe Island, with "Sandringhams."
8) Various internal services to New Guinea and Papua and to adjacent islands.

STATISTICAL REPORT: QANTAS EMPIRE AIRLINES *Jan.-June*

	1939-40	1945	1946	1947	1948	1949	1950
Passenger miles flown	10,275,818	23,482,731	48,262,232	60,889,606	88,922,787	127,164,890	60,889,355
Passengers carried	8,454	26,012	24,918	30,421	33,867	57,674	37,153
Miles flown	1,673,016	5,083,449	5,947,347	6,275,095	6,527,790	9,220,076	4,476,956
Hours flown	12,661	31,426	34,432	37,538	37,896	51,448	25,361
Cargo ton miles	186,733	2,348,273	560,995	1,107,647	1,294,745	4,938,632	2,587,002
Mail ton miles	812,665	1,384,584	1,995,757	2,043,374	2,581,362	4,284,916	1,947,101
Route miles open	6,524	—	13,825	23,843	26,451	30,158	33,000

A Douglas DC-4 at Norfolk Island airstrip.

In spite of all these developments, which have brought QEA's staff from 3 in 1920 to 3,825 at the end of 1949 and the route mileage from 577 miles in 1922 to 33,000 in 1950, the Company is still on the look-out for fresh worlds to conquer. Thus, in November, 1948, they carried out a 14,872-mile survey flight to South Africa; the precursor of yet another major trans-oceanic air service?

The past thirty years have seen tremendous strides in aviation. Perhaps few companies exemplify this progress better than QANTAS Empire Airways, which has grown during these thirty years from an obscure venture in the far-off Australian backwoods to a man-sized company able to take its place with pride among the great of the aviation world.

What's in the Air?*

FULL LIFE-HISTORY, PLEASE

It is already a well-known fact that official curiosity does not always help to speed up traffic. Nevertheless every day provides fresh evidence that with a little thought still further additions to the "paper barriers" can be invented.

The latest contribution was made by the US Immigration authorities during October, 1950.

On 3rd October the *Subcommittee on Facilities* of the Air Co-ordinating Committee (under the American Civil Aeronautics Board) published a list of the measures taken during the previous year to simplify and speed up international air travel to and from the USA. They pointed out with pride that, inter alia, transit visas were no longer necessary for passengers flying across the USA, that health inspections for transit passengers had been abolished, etc... But the *Subcommittee on Facilities* had reckoned without the immigration authorities. As is known, the American Congress recently passed a National Security Act ("McCarran" Bill) which requires any foreigner wishing to visit America to prove that he has never belonged to any Communist or Fascist organization. The necessity for or the expediency of such an Act will not be discussed here. It is the American legislature's own affair what measures they consider to be necessary, in present-day unsettled conditions, to safeguard the American nation. The only interesting aspect, from the aviation standpoint, is the zeal of the American immigration authorities, who thought themselves obliged to demand *literal* proof of anti-Fascist sentiments even from the crews of Italian shipping and aircraft companies (e.g. the crews of Linee Aeree Italiane), i.e. from men who as a rule spend only a few hours, as like as not asleep, at an American port or airport, before starting on their return trip and who certainly would be hard put to it to find time to indulge in subversive activity on American soil. That the detailed investigation of the political antecedents of even the most modest of flight engineers would inevitably put a stop to all air traffic was obvious. As was to be expected, the Italian Ambassador to Washington protested, and equally obviously the immigration authorities were finally instructed by the State Department to withdraw this ruling. The Italian flight engineer will therefore no longer have to tell the Immigration Officer his whole life history, and the authorities will confine themselves to keeping an eye on the thousands of anxious travellers who for weeks past have been besieging American embassies and consulates in Europe and elsewhere to get the official O.K. before leaving for America... A particularly painful experience was that of an Indian businessman who had already started on his journey to the USA, and had got as far as London on a TWA aircraft, when the new regulations were issued. When he wanted to fly on to New York he was told he would first have to return to Bombay and get a new "purged" visa from the American Consulate there...

Fortunately, on the other hand, there is no lack of instances of the growing understanding for modern transport requirements.

M. Stéphane Thouvenot, Director of Air Transport and Air Navigation under the Secretariat General for Civil and Commercial Aviation in France recently relinquished this post for that of Deputy Director-General of IATA in Montreal. One of his last official actions in France was the abolition of flight manifests for internal French air services and services between France and North Africa. Similar concessions on services between France and Belgium are being prepared.

American tourists to the *Argentine* no longer require visas. Similar measures were taken a few weeks ago by Bolivia, Ecuador, Venezuela, Chile and Uruguay.

The *Italian Minister for External Trade* has ordered the abolition of the regulations requiring foreign air carriers to pay transport dues for passengers and freight in Italian currency.

New Fokker plant under construction at Schiphol.

Fred T. Smye, hitherto Assistant General Manager of A. V. Roe (Canada Ltd.), has joined the Board of Directors as Vice President in charge of production.

RECORD BALANCES IN AVIATION INDUSTRY

Even though the boom conditions produced by the Korean war have not yet taken effect, aircraft works in USA and Europe are showing record balances.

Consolidated Vultee has never produced such favourable results since Odlum moved into the Company. For the second quarter of 1950 (up to 31st August) a net profit of $1,069,784 is reported, with $5,536,311 for the preceding nine months. Sales during these nine months amounted to $191,000,000. The cost of the "Convair-Liner" has thus been written off at last, the final $11,000,000 bank loan having been paid back recently.

Boeing Airplane Co., too, was able to close the first nine months of 1950 with a net profit of $8,210,252, or $7.58 per share.

Even *Northrop* succeeded in working its way out of a loss last year ($3,800,000 due to cancellation of orders for the three-engined C-125 "Raider"), and have estimated a modest profit of some $680,000 for the first quarter of their 1950/51 financial year (1st August to 31st July).

And *Fairchild* declared a dividend of $0.40 a share payable on 28th November, bringing the total dividend for the current year up to the highest figure ever paid by this Company.

On this side of the Big Pond the British *Blackburn & General Aircraft Ltd.*, show a profit of £608,132 (before deduction of tax), thus considerably exceeding

The Piper "Super Cub" taxying over rough ground.

Dr. Joseph Escher, elected to the Swiss Parliament as successor to Enrico Celio, has been appointed head of the Swiss Department of Posts and Railways (to which the Air Office is attached).

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A North American AJ-1 attack bomber landing on the aircraft carrier "Coral Sea."

their previous year's profit of £389,496. The *difficulties experienced by certain Italian concerns*, on the other hand, show clearly the extent to which American and British prosperity are attributable to increasing armament production.

Because of the complete absence of a military construction programme, the Italian SIAI-Marchetti Company is suffering from a serious lack of orders, and Ernesto *Breda* had to discharge its remaining staff of 900 and temporarily suspend all aircraft production, when its order from the Argentine for three four-engined Breda "Zappata" BZ. 308 transports was cancelled. The Italian Defence Minister has since stated that he would be prepared to place orders worth 1,000,000,000 lire provided Breda themselves can find investors to finance production. La Malfa, Under-Secretary for State Investments, admitted that the coffers of the State Finance Funds were hopelessly empty.

*

Although it is clear that the upward movement in the American industry is due primarily to increased military production, it must also be admitted that the more important suppliers of commercial aircraft (Douglas, Lockheed, Boeing, Martin) are making strenuous efforts to liven up the civil market and that these efforts have already produced some very satisfying results. For example, Douglas announced on 15th October that they had orders valuing $625,498,840, in hand, including 91 orders for DC-6s (totalling $100,000,000). Air transport companies who have ordered these machines include PAA (18), Swissair (2), American Airlines (11) and United Airlines (14).

Incidentally United Airlines' order for fourteen new DC-6Bs has given rise to a certain amusement among the initiated, for UAL had just sued Douglas for damages for faulty design of two earlier DC-6s which crashed in 1947 and 1948. Today's order seems to show on the one hand that the alleged "defects" in the earlier deliveries cannot have been so grave and on the other that a law suit by a customer just seems to be another way of carrying on friendly business relations in these days of boom and shortages.

MADE-TO-MEASURE AIRCRAFT... FOR FARMERS

American farmers have always been the most progressive in the world, so it is not surprising that today aircraft figure among the machinery of many an agricultural concern in the USA.

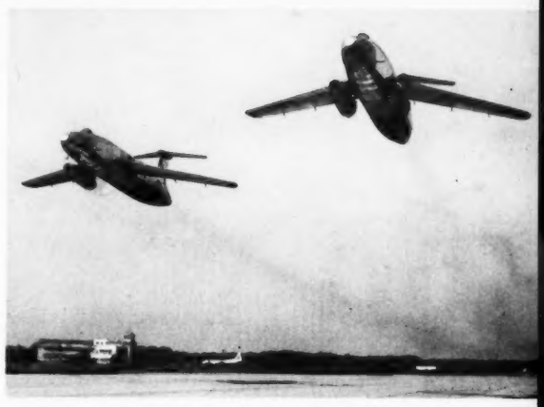
Crop dusting, fertilising, supervision of pastureland from the air—none of this is new. The conversion of the cowboy from 1 h.p. to 200 h.p. has long been under way. Numerous makers of sports and touring aircraft (particularly the various helicopter firms) have recognised these new possibilities and in recent years have put on the market several aircraft especially modified for agricultural purposes. As a rule these have been developments of existing types. Piper, for instance, converted the well-known « Super Cub » and provided it with "supplementary agricultural equipment." Bigger landing flaps produced a lower minimum speed and a specially designed four-wheel undercarriage made it possible to take-off or land on any kind of field.

But the farmers were not satisfied with converted sports machines. Backed by the National Flying Farmers Association, the Civil Aeronautics Administration and the Department of Agriculture of the American Government, a group of designers from the Personal Aircraft Research Centre of Texas Agricultural and Mechanical College recently designed a light single-seater for agricultural uses. Construction of the prototype has already begun.

US Navy pilots practising formation flying. A patrol of three four-engined Martin P4M-1 "Mercator" patrol and anti-submarine aircraft. These are fitted with two Pratt and Whitney R-4360 piston engine and two Allison J-33 jets in the same nacelles. Note the radar blister underneath the fuselage.

This "made-to-measure" single-seater is an all-metal low-wing monoplane with open cockpit, single tail unit and fixed tail wheel undercarriage. A 200 h.p. engine promises good take-off and climbing performance and being relatively powerful should ensure adequate power reserve for the low flying essential in agricultural work. The design naturally provides for the maximum possible payload (roughly 2000 lbs.) of fertiliser, seed, anti-pest preparations, etc.

Series construction of twin-engined Northrop F-89 "Scorpion" intereceptor fighters at Northrop Aircraft Inc., Hawthorne, California. Over a hundred of these jet fighters have been ordered by the USAF.



The Martin XB-51 is a three-engined jet bomber for ground support missions. The two XB-51 prototypes in flight.

FLIGHT TRIALS

The US Navy Air Service recently completed a further phase in the trials of their North American AJ-1 attack bomber, viz :—deck landing trials. Unfortunately another of these aircraft was lost during the trials. It crashed into the sea shortly after taking off from the aircraft carrier "Franklin D. Roosevelt." This was the fourth aircraft of this type to crash.

Glenn L. Martin are continuing the trials of their *Martin XB-51* three-engined jet bomber, though structural details and performance are still unobtainable. In any case this aircraft with swept wings and tail unit is said to be very fast. And its armament, which, according to American sources, comprises eight 20 mm or four 75 mm cannon and 12,000 lbs. (5,400 kg) of bombs, seems to indicate that the *XB-51 will be well equipped for ground strafing.*

NEW JET AIRCRAFT... ON PAPER

The Italian Macchi concern have taken the first step towards the resumption of fighter construction. Engineer Ermanno Bazzocchi, of Macchi, is at present engaged on a design for a jet fighter, to be known as the *Macchi M.B. 324*—Mario Castoldi, designer of the Italian single-seater fighters M.C. 200, M.C. 202 and M.C. 205, which made a name for themselves during World War II, and of a number of racing aircraft built by Macchi before the war, is also active again—at present evidently on his own account. For a time Castoldi was working on the design of two jet fighters, the C. 206 and C. 208, derived from the M.C. 205 piston-engined fighter, but later he abandoned these. It is now reported that he is working on a new jet-propelled type. Apart from the name, *Castoldi C-209*, no details are available.

Similarly, little beyond the type designation is known of the *Short S.B. 1* long-range bomber planned by the British firm of Shorts, Belfast. However what information is available seems to indicate that it is a heavy (swept-wing) aircraft and is to be fitted with jet engines.

PROFILE OF THE MONTH...

The Paradoxical Mr. Kindelberger

James Howard Kindelberger.

James Howard Kindelberger is the man who has made North American Aviation Inc., one of the most successful aircraft manufacturing concerns in the world. Many an outsider will regard him as a bundle of paradoxes. Known by all as "Dutch" Kindelberger, he has not a drop of Dutch blood in him but is of German extraction. On the other hand, he is as un-German as a typical, direct and exceedingly charming West Virginian can be. He is a little hard of hearing, as many another aviation pioneer, but he will understand every word you say if he so desires. He is the Chief Executive Officer of North American—but not the President, who is normally the top executive : Kindelberger is the Chairman of the Board, a job frequently occupied in other concerns by benevolent elderly gentlemen content with keeping a fatherly eye on the business but generally resting on their laurels. He is a mechanical genius, a gadget-minded American ; he is also a hard-driving bargainer and businessman. He started work as a factory apprentice, learned everything there was to learn about mechanical engineering, now lives in a robot-controlled mansion—and grows orchids in his spare time.

In practical life, "Dutch" Kindelberger is not paradoxical at all. He is a man who knows what he wants and gets it by clear thinking and a vast expenditure of energy. His rags-to-riches career is in the best American tradition, though more meteoric than most others (true, meteoric careers are the rule rather than the exception in the still-young aircraft manufacturing industry).

He was born in Wheeling, West Virginia, on May 8th, 1895, as the son of a moulder. At the age of 16 he left school to work for the National Tube Company in his hometown, earning all of five dollars for a six-day week. Through correspondence courses he studied mechanical engineering at night, and in 1913 took a job as civilian draughtsman and inspector with the US Army Engineering Corps. Three years later he entered Carnegie Institute of Technology, where he terminated his formal education in May, 1917. He then re-joined the Army Engineering Corps, this time as a soldier.

Although the USA had by then entered World War I, Kindelberger spent the first six months of his soldiering career on civilian projects. He therefore applied for transfer to the Army Air Service—a move which had a decisive effect on the rest of his life : he never left the field of aeronautics again.

Dutch went through all the stages of flight training and was made an instructor at Park Field, Memphis, Tenn., rising to the exalted rank of lieutenant. He admits himself that as a pilot he was not absolutely outstanding.

America's participation in that war was not of very long duration. The armistice was signed in November of the next year, and a month later Kindelberger—he was still in uniform—went to work as a draughtsman for the Glenn L. Martin Company's plant near Baltimore. By 1920 he was Chief Draughtsman and Assistant Chief Engineer. Martin's place must have been a fertile breeding ground for successful aircraft manufacturers : Dutch's boss, the Martin Chief Engineer, was Donald W. Douglas, of Douglas Aircraft fame.

It wasn't long before Donald Douglas decided to become his own master and resigned from Martin to form the Douglas Aircraft Company in Los Angeles. He asked Kindelberger to join him in California, but Dutch preferred to stay on the East Coast a little longer, "to save up the railway fare" to California, he says. By 1925 he had evidently saved up enough, for he followed Douglas to the West Coast and became his Chief Engineer. His team consisted of nine engineers : when he left the company nine years later, he was Vice-President in charge of Engineering and headed a technical staff of 400 engineers !

Those were fruitful years for Dutch—and they seem to show up another paradox. Kindelberger supervised the engineering side of the Douglas DC-1 twin-engined transport, the prototype of the DC-2. The latter type of aircraft—ancestor of Douglas' family of great airliners and military transports : DC-3, DC-4, DC-6, C-74, C-124—accelerated the revolution in air transportation initiated by the first modern twin-engined low-wing aircraft, the Boeing 247D. Having thus played an effective part in this air transport revolution, Dutch left Douglas and from then onwards turned his back on civil transports and hitched his waggon to a military star. His new job was with a subsidiary of North American Aviation, which he joined in July, 1934.

North American Aviation Inc., had been formed as a holding company in the boom year of 1928 when money was plentiful and investors believed anything connected with aviation was bound to hit pay-dirt. In effect, North American was one of three very large concerns, the other two being United Aircraft (now larger than ever) and Aviation Corporation (still in existence but considerably shrunk).

North American's interests consisted of a number of air transport companies (including what later became Eastern Air Lines) and manufacturing plants. The largest of these had been the *General Aviation Manufacturing* of Baltimore, Ltd. Within the North American organization Kindelberger assumed the presidency of General Aviation in 1934 and migrated back to Baltimore.

General Aviation had been formed in the 'twenties by Antony Fokker, the great Dutch aircraft designer, manufacturer and salesman, during his stay in the USA. The growing General Motors concern had helped him with the establishment of the new firm and soon held large interests in North American. Fokker lost a lot of money on General Aviation, and after several years he quit and returned to Europe. General Motors continued to operate the concern for a number of years, losing money all the time, without producing anything remarkable. The best-known type no doubt was the General Aviation Clark GA-38 single-engined low-wing airliner, of which Swissair bought two—nobody has ever discovered why.

In 1934, the year in which Kindelberger came to General Aviation, the great American air mail contract scandal shook the aviation industry, and Congress

North American Aviation's headquarters plant at Mines Field, Los Angeles (L.A. Municipal Airport).

The plant at Long Beach municipal airport, South of Los Angeles. Only part of the facilities are occupied by North American. Douglas at one time built its C-74 giant transports there. Signal Hill, with its forest of oil derricks, is in the background.

1918 : Lieutenant "Dutch" Kindelberger beside his Curtiss JN4D. He was an instructor during World War I.

1920 : "Dutch," then Chief Draughtsman and Assistant Chief Engineer for Glenn L. Martin, in the cockpit of a Curtiss naval torpedo aircraft built by the Martin Company.

1926 : Kindelberger as Chief Engineer for Donald W. Douglas, standing near a Douglas T2P-1 naval biplane. At left is T. E. Springer, now factory manager at Douglas' El Segundo plant.

thereupon ordered the manufacturing concerns to divest themselves of all air transport majority interests. North American did as told, but kept a minority in EAL (and sold it two or three years later). As a result of this reorganization, North American became largely a manufacturing concern and merged with its subsidiary erasing the latter's name, General Aviation, from the books on January 1st, 1935. Kindelberger stayed on as President of North American.

Dutch found that his new company was not doing very well. There was not much to do, and there were no orders worth mentioning. But he knew that the US Army Air Corps were organizing a trainer competition.

He had exactly nine weeks to knock the aircraft together. He also had just 75 mechanics—mostly Dutch (inherited from Fokker) and Scottish, to do the job. But night work was forbidden under the National Recovery Act of the depression years, which limited working hours to 40 a week.

Dutch called his men together. "No overtime," he warned, "or I'll be in the hoosegow."

Two-three nights later he found the workmen singing and yelling in the plant while building an aeroplane. One of the Dutchmen explained.

"After eight hours' work we ring out and go to Helen's place for beer. Then we come back and have fun building this job. There is no law against having fun . . ."

Dutch did not land in the hoosegow but won the trainer competition—and got an Air Corps production contract. On the strength of that order, Kindelberger moved North American to Los Angeles in 1936 into a rented factory at Mines Field, now Los Angeles Airport. Today the factory is no longer rented but, with vast additions, forms the headquarters plant of North American.

The trainer those Dutch and Scots built in Baltimore was the starting point for a whole series of aircraft. Originally designated NA-16, in its final version it was known as the AT-6 "Texan" or "Harvard," and the majority of Allied World War II pilots put in at least a few hours of flying in it. Britain ordered 200 in 1938, France had hundreds on order at the time of the 1940 collapse, Australia and Canada bought the manufacturing rights. In 1941 the company delivered the 10,000th aircraft of the type. Thirty-three countries ultimately adopted the basic design as their standard advanced trainer, and even now North American is "re-manufacturing" war-surplus AT-6 "Texans" it bought back from the WAA, selling them to various countries—at a considerable profit. In addition, it is building a large number of T-28 trainers—a direct descendant of the AT-6—for the US Air Force.

Dutch had previously exploited his basic design to the full. Variations of it were the NA-33 general purpose aircraft, the NA-44 attack bomber, the NA-25 single-engined reconnaissance three-seater, the NA-50, NA-68 and XP-64 single-seater fighters, some of which sold well and some didn't. One popular aircraft was one of Kindelberger's earliest, the O-47, of which hundreds were bought by the Air Corps *before* the war, when aircraft contracts usually involved ten or twenty machines.

North American's fame as a builder of first-class military aircraft spread as a result of the war. The B-25 "Mitchell" twin-engined medium bomber played an important tactical role in all theatres of war. And the P-51 "Mustang" fighter was a by-word wherever men fought in the air.

The latter type was originally built to specifications (not plans) supplied by the British Air Ministry. It saw the light of day as the NA-73 and was dubbed the "Apache" by the Americans. It had an 1,150-h.p. Allison V-1710-F3R liquid-cooled engine, was quite fast near the ground but had no performance at altitude. Thus, it did not have all the qualities of a fighter. Several squadrons were equipped with it, and it was renamed A-36 "Invader," and the Americans used it for dive-bombing and tactical close-support in North Africa. It was only after it had been equipped with a Rolls-Royce "Merlin" engine built by the Packard Motor

1929 : "Dutch" in the rear cockpit of a Douglas 02 with Lieut.-Col. S.J. Price, later of the US Army Air Forces, to whom he gave flying instruction. Later Price taught Kindelberger to drive a motor-car. Picture was taken in Cleveland, O.

North American became famous for its trainers before the war. Kindelberger is shown greeting Brazilian Air Force officers taking delivery of training aircraft in the late 'thirties.

The P-51 "Mustang" fighter conceived in 1940 was one of the outstanding aircraft of World War II. Ten years later it was still service in Korea. "Dutch" Kindelberger poses in front of one.

North American trainers are used by 33 different countries. Here "Dutch" shows a trio of French Air Force officers through the Los Angeles plant. At extreme right : R. H. Price, Vice-President and Chief Engineer. Electric wiring on the table is usually referred to as "Spaghetti."

The Downey, Cal., plant of North American Aviation.

Kindelberger confers with a workman and a foreman on the F-86 "Sabre" final assembly line.

North American Aviation is now delving deep into guided-missile research and development. "Dutch" Kindelberger confers with Dr. Fritz Feldmann, Supervisor of the Company's supersonic wind tunnel, the largest in the aircraft industry.

The B-45C "Tornado" four-jet bomber with wing-tip tanks to increase the aircraft's normal tactical radius beyond 800 miles.

Spurred by a Rato rocket under each wing, the B-45 makes a spectacular take-off at Edwards Air Force Base, Cal.

The F-86 "Sabre" fighter on the NAA ramp, Los Angeles plant. Nearly 600 were on order before the Korean affair. How many have since been ordered is a secret.

A development of the "Sabre," the North American YF-86D high altitude interceptor. The YF-86D has a modified General Electric J-47 jet engine with an after-burner. Radar equipment is carried in the nose bulge.

The North American AJ-1 three-engined (it has a jet in the tail for bursts of extra speed) attack bomber. It is destined to carry atom bombs off carrier decks.

North American is now delivering numbers of its new T-28 trainers to the US Air Force. Its performance is much improved over the company's earlier trainers, but it still has that typical North American look.

Belching flame, the NAA guided missile "NATIV" streaks from its launching tower at the isolated firing range on the Holloman Air Force base, near Alamogordo, New Mexico. The "NATIV" (North American Test Instrument Vehicle) is 13 feet long and measures 18 inches in diameter.

Company under licence that the P-51 came into its own. The Americans soon adopted the British name "Mustang," stuck long-range tanks on it and got as many as they could lay hands on for their own Army Air Forces. Its triumphs in the German and Japanese skies are matters of history, and at this moment it is still showing its mettle in the Korean War.

During the war period North American altogether built 42,000 trainers, "Mitchell" bombers and "Mustang" fighters, and it also produced Consolidated B-24 "Liberator" bombers under licence in a separate factory in Texas.

The end of the war presented a dilemma to the entire aircraft industry : what to do with all the huge manufacturing facilities and labour forces ? Kindelberger attacked the problem with characteristic clearsightedness, avoiding most of the mistakes other aircraft manufacturers were about to commit in their rosy, post-war optimism. Should we produce civil transport aircraft, private airplanes, non-aeronautical goods ? he asked himself. Plans for an airliner were ready, the private market seemed insatiable. Dutch turned thumbs down on transports : Lockheed, Douglas, Convair, Martin, Boeing, Republic were all building transports—and they lost hundreds of millions of dollars over several years. Non-aeronautical goods ? No, said Kindelberger, we could never sell our "precision-engineered" pots and pans as cheaply as the hardware manufacturers. Other aircraft manufacturers have since proved him right.

Private aircraft ? Yes, said Dutch—and that is where he made his mistake. He produced the "Navion," one of the most luxurious private aircraft there ever was. Each machine cost $10,000 to build, but sold for $7,500. Not too proud to acknowledge his own mistake, Kindelberger in 1947 sold out the project to the Ryan Aeronautical Company, of San Diego, California. (Hundreds of "Navions" have since been bought as liaison aircraft for the US Army). For that year, Dutch Kindelberger reported his only financial loss in considerably more than a decade : a modest $28,259, compared with millions by other manufacturers.

Dutch had learned the hard way, during the war, what it means to get the production lines rolling full speed. Not long ago he warned his friends that, in the event of an air war with Russia, America could not hope to gain air superiority before 1954—PROVIDED America's aircraft production facilities remained immune from air attack or serious sabotage. When the present emergency resulting from the Korean war arose, Kindelberger was ready. By continuing in the military aircraft field, by constantly developing new types, he had kept his engineering team together. He had obtained a production order—relatively large for peace-time conditions—for nearly six hundred F-86 "Sabre" fighters, one of the world's fastest types. He was building a number of B-45 "Tornado" bombers, the first four-jet type of aircraft to fly in the USA. For the Navy he had produced a batch of FJ-1 "Fury" jet fighters and was building a series of AJ-1 attack aircraft. He had started his company on a programme of basic research on atomic energy and guided missiles, "to be in on the ground floor if anything is uncovered."

The result is that Kindelberger's organization is again doing its share in the defence of the Western World. North American again has a labour force of over 25,000 people, a backlog exceeding $500,000,000 for military aircraft. Dutch plays his role with enthusiasm. He has three reasons to be enthusiastic : he is proud of his own, individualistic way of life and ready to defend it ; he is proud of the splendid record of North American Aviation Inc. ; and it pays—Dutch can indeed be described as the man who in Baltimore took over a lame-duck plant and in California found it to be the goose that keeps on laying golden eggs.

A hard-working, hard-bargaining businessman . . . He also grows orchids on his estate in Pacific Palisades, California. He loves mechanical efficiency. He has invented and built a supersonic whistle which, attached to the front bumper of his car, opens his garage door. He has designed a "dream" house with hundreds of electric motors which retract beds, open and close windows, do away with most servants. He lives in the place. He also loves outdoor cooking-parties—barbecues, as they call them in the USA.

A paradox of a man ? Rather a man who has come a long way and has not forgotten how to be human.

THE GOOSE THAT LAYS THE GOLDEN EGGS

North American Aviation's Financial Success

Year	Profit $	Sales $
1938	1 904 085	10 062 345
1939	7 088 091	27 608 651
1940	7 090 336	36 862 514
1941	6 075 954 [1]	60 865 687 [1]
1942	10 400 000	—
1944	8 389 967	—
1945	7 820 309	400 401 514
1946	4 000 000	56 642 000
1947	28 259 [2]	20 508 991
1948	6 779 561	94 782 739
1949	7 306 409	124 734 509
1950	—	—

These figures are eloquent : they show how North American Aviation got into the big money in 1939 when its trainer deliveries to the US and British air forces began to assume proportions. 1940 and 1941 were years of transition—NAA was changing over to fighter and bomber production. 1945 was the last year of the war (NAA fiscal year ends September 30th), by which time the volume of deliveries had reached astounding proportions. 1946 was a year of marking time, but the company filled it in by reconditioning and "re-manufacturing" war surplus trainers and fighters destined for a dozen foreign nations. "Navion" production had been started. 1947 marked the sale of the "Navion" project to Ryan, at great loss to North American, expressed in a small balance-sheet loss. In the following year NAA supplied fighters to the Navy, in 1949 jet fighters and bombers to the USAF, more orders and deliveries are now expected. The 1950 profit, not yet announced, is expected to exceed the 1949 figure.

[1] 9-month period, due to a change in company's fiscal years.

[2] Loss.

IATA to Fight for "Fifth Freedom"

A First Result of the Sixth General Meeting

Delegates representing fifty international airlines flew more than one million passenger-miles to San Francisco to attend the *Sixth Annual General Meeting of the International Air Transport Association* from October 16th to 20th, 1950 (cf. INTERAVIA Review, Vol. 5, No. 8-9).

The most outstanding feature of the meeting was IATA's recommendation that the *operators themselves* should seek to work out a reconciliation of the Fifth Freedom interests of long-haul and regional carriers rather than leave the field open to restrictive government legislation. It may be significant that this proposal was put forward on the occasion of IATA's first meeting in the United States—for it is the USA which had originally been the stoutest advocate of Fifth Freedom rights in air transportation. Apart from this the meeting was devoted to the usual reviews of results achieved in the past twelve months, forecasts for the future, a few lectures, and considerable social activity.

Less than three weeks after the San Francisco meeting, namely, on November 8th, a IATA official disclosed in Montreal that the first *practical* step towards a review of the whole contentious problem of the Fifth Freedom in international air services will be taken very shortly. It will take the form of a poll of the Organization's members on the measures IATA can adopt to further this aim.

The Annual General Meeting had voted to have the Executive Committee of IATA set up a special panel to study what can be done to break up the impasse that has developed in the air transport world over the exercise of Fifth Freedom rights. To this panel will be made available the views obtained by means of the poll on how the international operators could avoid the hitherto inevitable clash between long-haul and regional airlines flying parallel routes in competition with each other.

The world is indebted to the 1944 International Civil Aviation Conference of Chicago for the inclusion in the aviation glossary of the term "Fifth Freedom." Simply, it means the rights of an international air operator to pick up and discharge passengers anywhere along an international route.

Efforts to draw up a general code for the exchange of commercial rights in the air have so far resulted in little more than the compilation of varied, complex and irreconcilable views by the International Civil Aviation Organization, in whom the Chicago Conference reposed its hopes and faith for the orderly and equitable development of the world's air space. Meanwhile, negotiations for the exchange of flying privileges have been conducted bilaterally or between individual nations, in an atmosphere of horse-trading which the idealism of Chicago sought to avoid.

IATA has now expressed its desire to take upon its shoulders the task which has hitherto been the principal concern of governments. Member airlines were warned at the meeting that some governments were getting "tougher and tighter" in writing bilateral air transport agreements to protect their national interests, and it is to prevent this "toughness" from spreading that IATA operators will endeavour to work out their own solution.

Dr. Edward P. Warner, President of the ICAO Council, which has wrestled with the multilateral agreement problem for many years ; Delos C. Rentzel, Chairman of the US Civil Aeronautics Board ; Walter A. Radius, head of the Transportation and Communications Division of the US State Department, and Warren L. Pierson, Chairman of TWA and new IATA President, have expressed their satisfaction that IATA is interested in the Fifth Freedom problem. In a report to the ICAO Council, Warner stated his belief that "if the airlines could reach some measure of agreement among themselves on the sort of regulation or restriction to which they think the competitive pattern should be subjected, it would be easier for the governments to find a basis of agreement . . ."

It has long been contended that on parallel routes the small operator suffers in competition with the long-haul operators using larger and more efficient equipment. At San Francisco it was suggested that a rate differential might be the answer to the problem of bringing about equality of conditions to the two operators. IATA headquarters pointed out that this method is to be tried this summer in the Middle East Region, where carriers operating between Greece, Egypt, Cyprus and Iraq will charge slightly lower fares to meet competition from the plush, rapid transit service offered by the Fifth Freedom operators.

The view that the airlines themselves were the best judges of what was proper and equitable was voiced by Dr. George P. Baker, Professor of Transportation at Harvard University, who delivered the Annual IATA paper on "Looking Ahead in International Transportation." Dr. Baker declared that airlines of several nationalities frequently plied parallel international routes, often providing more capacity than might be needed for economical operation. Their continuing operation, however, was justified in terms of national interest and, if adjustments between carriers were necessary, they would best be made by the airlines themselves, not by governments.

The activities of IATA during the year were reviewed at San Francisco by Sir William Hildred, Director-General.

Some members of the Association were lagging in their efforts to banish unnecessary red tape and delay at international boundaries, he said. He hoped it would be possible for the airlines to change their attitude and adopt wherever possible, the standard procedures, forms and routines evolved by ICAO in co-operation with IATA.

The Director-General reported that the Clearing House operated by the Association in London has met the challenge of fluctuating currencies and levelled off many of the hardships operating companies would otherwise have suffered. As a case in point, the devaluation of the pound sterling was handled to the satisfaction of all members. During 1949 two-way turnover clearances rose by one-third from the previous year, in pre-devaluation terms, to US $166,000,000.

The "soft" currency country operators had been the principal victims of currency devaluations, Sir William said, chiefly because they had to pay as much as 40 per cent more on each hard dollar of expenditure than during pre-devaluation days. Advertising, booking offices and services all cost these airlines more, as did aircraft and parts purchased in the United States. Increase in cost of aviation gasoline increased the operating costs of some airlines by as much as 10 per-cent.

On the other hand, the Director-General reported, as a result of devaluation there was an immediate increase in tourists crossing the Atlantic from the United States to Europe because of the favourable rate of exchange. Westbound traffic showed a decrease but has been creeping back steadily to former levels.

Finally, Hildred disclosed that air cargo had shown the greatest increase. Westbound air cargo to the United States rose from 40 to 50 per cent compared with the same period before devaluation. Aircraft on scheduled services flew 1,400 million kilometres during 1949, 10 per cent more than the preceding year. Passenger traffic increased by 15 per cent. The safety record of international operations continued to improve.

*

While Warren Lee Pierson, of TWA, took office as President for the 1950-51 period, Sir Miles Thomas, Chairman of British Overseas Airways Corporation, was elected to the presidency of IATA for 1951-52. He will take office at the Seventh Annual General Meeting to be held in the United Kingdom next autumn.

The pleasures of a IATA meeting : Luncheon in the magnificent redwood grove at Muir Woods, near San Francisco. *Left to right :* Lady Hildred, wife of IATA Director-General ; Lord Douglas of Kirtleside, Chairman of BEA ; Madame Costa de Beauregard, wife of Air France Director Costa de Beauregard ; Dr. Albert Plesman, President of KLM ; Clive Adams, American Representative of BEA, and Mrs. Adams ; Sir William P. Hildred, Director-General of IATA ; and Lady Douglas.

A serious discussion at San Francisco. *Centre :* Juan T. Trippe, President of the gigantic PAA ; *right :* J. R. D. Tata, Indian industrial magnate and Chairman of Air India International ; *left :* Sir William Hildred.

Two Presidents. *Right:* Warren Lee Pierson, President of TWA, 1950-1951 President of IATA; *left:* Sir Miles Thomas, Chairman of BOAC and 1951-1952 IATA President.

Interested spectator: Donald W. Douglas at one of the IATA cocktail parties. Next to him are Ralph S. Damon, TWA President; Gordon R. McGregor, President of Trans Canada Air Lines; and Major J. Ronald McCrindle, BOAC's Adviser on International Affairs.

Elected to serve on the IATA Executive, in addition to members whose terms have yet to expire, were: Harold M. Bixby, Vice-President, Pan American World Airways; René Briend, Deputy Director General of Air France; Croil Hunter, President, Northwest Airlines; Gordon R. McGregor, President of Trans Canada Air Lines, and Dr. Albert Plesman, President of KLM Royal Dutch Airlines.

The Executive Committee announced the *nomination of Stephane Thouvenot,* at present Secretary General of Civil Aviation in France, as *Deputy Director General of IATA.*

The 1951 budget totalling $650,000 was approved by the meeting. This sum is to be raised chiefly through membership dues based upon the proportional amount of international payload carried by individual members.

After the Meeting delegates were invited to inspect a number of Californian aircraft factories. A party of guests at the Lockheed plant, Burbank. Left to right: John Wagner, Lockheed sales manager for Latin America, Dr. J. Bento Ribeiro Dantas, president of Services Aereos Cruzeiro do Sul of Brazil; Mrs. Gonzales, Mrs. Paulo Sampaio, wife of the president of Panair do Brasil; Dr. Jorge Gonzales, executive vice-president of the Colombian airline Avianca; Jean Basson, French consular representative in Los Angeles; Mrs. Wild and Herbert Wild, assistant traffic manager for Avianca; Henri Beaugard, French consular representative in San Francisco; Tom Self, writer for the US Aviation Week magazine; Mrs. Hymans, Mrs. Courtland S. Gross, wife of Lockheed vice-president and general manager; Max Hymans, chairman of the board of Air France; Henri Chappelet, Lockheed public relations representative; Carl J. Ehrnrooth, member of the board of the Finnish Aero O-Y airline, and James Leicester, resident representative at Lockheed for Air France.

The social side of IATA's Sixth Annual General Meeting was not limited to the usual cocktail, dinner and luncheon circuit. This was due to a combination of several factors: first, California in October has a lot more to offer than most other places at the same time; second, Californians are firmly convinced that they *have* to offer more than anybody else on carte; and third, never had so many top executives from so many airlines of so many countries been, at the same time, in California, the biggest centre of American commercial aircraft production. And never had the reception committees of Douglas Aircraft Co., Lockheed Aircraft Corp. and Consolidated Vultee Aircraft Corp. striven so hard to outdo each other in rolling out the red carpet as on the days following the end of the Meeting.

On Saturday, October 21st, Donald Douglas sent two (Douglas, of course) aircraft to San Francisco to ferry IATA delegates and their wives from San Francisco to Los Angeles. They arrived there in time for gold-braided visits to the current football game and had the choice of spending an evening in night clubs or expensive seats at the Sadlers Wells Ballet. Sunday was the turn of Lockheed's Robert Gross, and the Delegates and their ladies were afternoon guests at his home. On Monday, Donald Douglas treated the delegates to a morning symposium of talks by his Chief Engineers, a luncheon, and an afternoon tour of his Santa Monica plant, where Douglas DC-6s are rolling off the production line.

On Tuesday, Robert Gross lunched and toured them at Lockheed Air Terminal, Burbank, and had the new L-1049 "Super-Constellation" take off on a demonstration flight.

Meanwhile, Floyd Bostwick Odlum, Chairman of Consolidated Vultee Aircraft Corp., and President of the Atlas investment corporation, played his usual lone and cautious hand. To popularize his "Convair-Liner" and his equipment finance company, Air Fleets Inc., carefully selected guests at his palatial desert home were several existing and potential future clients: Dr. Albert Plesman, President-Director of KLM, who operates a fleet of "Convair-Liners"; Dr. Max Hymans, Chairman of Air France, who would like to buy a fleet of such aircraft; Gilbert Périer, President of Sabena, Belgian Airlines, who already has several aircraft of the type; and Jesus Rubio Paz, Chairman of IBERIA, Spanish National Airline, who wants to buy new medium-range equipment as soon as he can lay hands on the necessary dollar exchange.

They had a pleasant time in the sun. Nobody talked about buying or selling aeroplanes. But it is always a good idea to be on friendly terms with one's clients.

Book Reviews

Précis de Droit Aérien, by Otto Riese and Jean T. Lacour.—Published by R. Pichon & R. Durand-Auzias, *Paris*; and F. Rouge & Cie. S. A., *Lausanne,* 1951.

Although Switzerland does not play a star part in air transport she is nevertheless—as a transit country and traffic centre par excellence—well placed to take a close interest in the economic, political and legal aspects of aviation. That she is well aware of her responsibilities in this direction is illustrated by the fact that two first-class text books on air law have been written by Swiss authors within recent months. "Luftrecht," by Otto Riese (in German) has already been reviewed in these pages (INTERAVIA Review of World Aviation, Vol. 5, No. 1-2). The present French book, *"Précis de Droit Aérien"* is by no means merely a translation or re-hash of Riese's earlier work, on which it is based. The matter has been arranged in accordance with the uses of Roman law, valuable additions have been made (including practical tables), new material included (penal law) and the whole presented with an originality which betrays the hand of Lacour, the co-author (Professor Extraordinary at the Institut Universitaire des Transports et d'Administration Maritime, Geneva). Both of the books by these Swiss air law experts deserve international recognition. (French.) He.

Die Welt des Fliegers, by Robert Knauss.—Published by Frank'sche Verlagsbuchhandlung, Stuttgart, 1950.

Aviation, like youth, never stands still. There is therefore always room for new books on world aviation as reliable, easily readable and well illustrated as this volume by Robert Knauss. This is true of all countries but perhaps particularly so of Germany, who, if she is ever to repeat some of her feats of the past in the civil aviation world, must keep alive German interest in aviation. Dr. Robert Knauss, whose aeronautical experience has already been mentioned earlier in this Review, is undoubtedly well-fitted to be the torch-bearer. (German.) He.

Is the Propeller-Driven Fighter Obsolete ?

by GORDON M. GOLLOB, Kitzbühel

The air forces of the Great Powers are today making feverish efforts to equip their fighter units with jet fighters. Aircraft of this category, fitted with swept-back wings, have reached speeds around 680 m.p.h. (1100 km/h), beyond which it is impossible to go without crossing over into the supersonic range. " Old-fashioned " fighters with reciprocating engines, on the other hand, cannot fly above about 500 m.p.h. (800 km/h) and are therefore often regarded as of no further interest.

But is this really so ? Are piston-engined fighters to be regarded as out-of-date ? Or might there not be grounds not only for retaining them in service but, above all, for perfecting their technical qualities and improving their performance ? The present article proposes to examine the essential aspects of this question.

Selection of comparative types

A comparison between jet fighters and reciprocating-engined fighters will have to be based on today's operational types, i.e., as far as jet fighters are concerned, on types such as the Russian MIG-9 and YAK-15, the American Lockheed F-80 (and F-94) " Shooting Star " and Republic F-84 (and F-96) " Thunderjet ", the British Gloster " Meteor " and De Havilland " Vampire ". We shall select as representative of this group (fighters without swept-back wings) a relatively recent design series of the last-named type, namely the " *Vampire 6* " with a D.H. " Goblin " engine of 3300 lb (1500 kg) thrust (fig. 1), which, as is known, is used in large numbers by the air forces of the Atlantic Pact nations and by Sweden and Switzerland.

The above-mentioned static thrust corresponds to a flying thrust of 2860-2970 lbs (1300-1350 kg). A comparable propeller-driven fighter would have to have a maximum engine output of 3000 to 5000 h.p., depending on the propeller efficiency and the speed chosen for the purposes of the comparison. The only type in this category at present is the British Westland " Wyvern T.F.2 " carrier fighter, fitted with an Armstrong-Siddeley " Python " propeller-turbine engine with an equivalent output of 4110 h.p. and contra-rotating propellers. Performance details for this machine, however, are not available. The *Hawker " Fury I "* piston-engined fighter prototype with a 3,000 h.p. Napier " Sabre 7 ", whose flying performance is known, will therefore be used for comparison with the " Vampire " (fig. 2). [1]

However, there are considerably faster jet fighters in production—and in some cases in operation—than the types mentioned above. They are fitted with more powerful engines, and almost all have swept-back wings and attain speeds of over 620 m.p.h. (1000 km/h) with a correspondingly higher rate of climb. Examples are the American Lockheed F-90 and North American F-86A (and F-93) " Sabre " (fig. 3 ; world speed record 670.98 m.p.h. or 1079.84 km/h), the British Hawker P. 1081 and Supermarine 535, and the Russian MIG-15 and LA-17. Unfortunately the flying performances and other details of modern high-speed jet fighters are a strict military secret, so that the only types that can be used for the present comparison are German designs of the later war years. Two Blohm & Voss designs, for which very accurate flying performances were worked out, have been chosen, viz :—the *P 209* (with

[1] Only versions with 2,500 h.p. Bristol " Centaurus " engines are in operation, viz :—the " Sea Fury 10 " and " Sea Fury 11 " carrier-borne fighters (Great Britain, Canada, Australia, Holland) and the " Fury Mk. 1 " land-based fighter (Iraq, Egypt) and " Fury F.B. 60 " (Pakistan). They have a slightly lower performance than the prototype.

Table

Aircraft type		"Vampire 6" jet fighter, series model	"Fury I" piston-engined fighter prototype	F-86A "Sabre" high-speed jet fighter, series model	P-209 high-speed jet fighter, design	P-212 high-speed jet fighter, design	P-208 piston-engined fighter, design
Engine (type) Take-off power or static thrust		D.H. "Goblin 3" 1500 kg (3300 lbs)	Napier "Sabre 7" 3000 h.p. + WM [1]	G.E. J-47 2360 kg (5200 lbs) — WM [1] 2720 kg (6000 lbs) + WM [1]	He S 011 1300 kg (2860 lbs)	He S 011 1300 kg (2860 lbs)	DB 603 L approx. 2070 h.p. —WM [1] — h. p. + WM [1]
Span Wing area	m m²	12.2 (40 ft.) 23.3 (251 sq. ft.)	11.7 (38½ ft) 26.4 (284 sq. ft)	11.3 (37 ft) —	8.1 (26½ ft) 14 (151 sq. ft)	10.0 [2] (33 ft) 14 (151 sq. ft.)	12.1 [2] (39½ ft) 19 (205 sq. ft.)
Armament type and no. Calibre Ammunition	mm	4 x Hispano 20 4 x 150	4 MG 20 600	4 MG 12.7	3 x MK 108 30 3 × 70	3 x MK 108 30 3 x 70	3 x MK 108 30 3 x 70
Mean flying weight	t	5.52 (12,200 lbs)	5.33 (11,750 lbs)	7.49 (16.500 lbs)	3.48 (7,700 lbs)	3.53 (7,750 lbs)	4.67 (10,300 lbs)
Max. speed at height	km/h km	880 876 834 0 5 10	680 770 700 0 5 10	> 1040 > 16	880 960 982 0 5 10	917 1002 1024 0 5 10	650 740 793 0 5 8
Absolute max. speed at height	km/h km	882 (548 mph) 2.5	773 (480 mph) 6.4	> 1040 (650 mph) —	988 (613 mph) 9	1034 (643 mph) 8.5	794 (493 mph) 9.5
Rate of climb [3] at height	m/sec km	25 17.4 10.1 0 5 10	27.7 23.4 7.0 0 5 10	— —	25.5 18 8.5 0 5 10	25.5 18 8.5 0 5 10	22.5 20 13.5 0 5 10
Climb to 10 km (32.000 ft.) in [3]	mins	10.3	9.2	—	13.5	14	13.3
Service ceiling	km	13 (42,600 ft)	12.5 (41,000 ft)	16.2 (53,000 ft)	12 (39,400 ft)	12 (39,400 ft)	12.5 (41,000 ft.)
Total endurance [4] at height	mins km	110 9	— —	— —	79 9	67 9	120 9
Range [5] at height	km km	1200 (745 miles) 10	approx. 1030 (640 miles) 6	2000 (1240 miles) —	1030 (640 miles) 9	1075 (670 miles) 9	1230 (765 miles) 9
Take-off run on grass Take-off run on concrete	m m	550 —	— < 350	— —	— 700	— 700	— 360

Notes : The figures are approximate. Most are taken primarily from manufacturers' announcements, but some are estimated. They are sufficiently accurate for purposes of comparison. They apply to aircraft without auxiliary fuel tanks or additional armament such as gun nacelles, rockets or bombs.

[1] + WM = with water and methanol injection.
— WM = without water and methanol injection.

[2] Including the two wing-tip control surfaces, each 1.25 m (4 ft. 1 in.) in span.
[3] Rate and time of climb with combat output.
[4] Total endurance including climb at combat output, then approximately maximum continuous output.
[5] Range at approximately maximum continuous output (without auxiliary tanks).

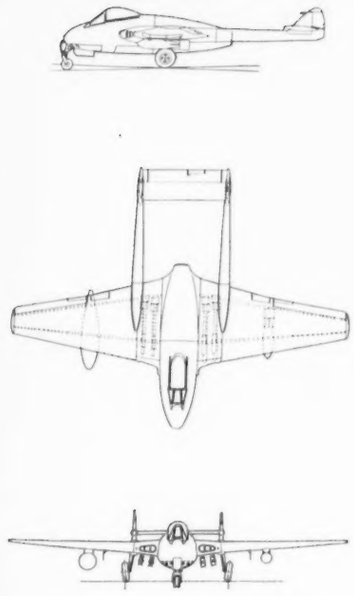


Fig. 1 : De Havilland DH-100 " Vampire 6 " with D.H. " Goblin 3 " jet engine of 3,300 lbs (1500 kg) static thrust.

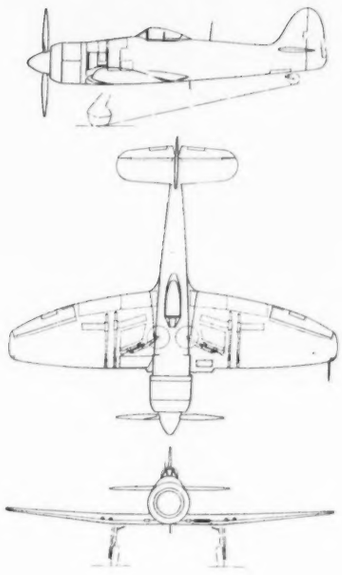


Fig. 2 : Hawker " Fury I ", prototype with 3,000 h.p. Napier " Sabre 7 " engine and five-bladed propeller.

Fig. 3 : North American F-86 " Sabre " with General Electric J-47 jet engine of 5,200 lbs (2360 kg) static thrust (6000 lbs = 2720 kg, with compressive cooling).

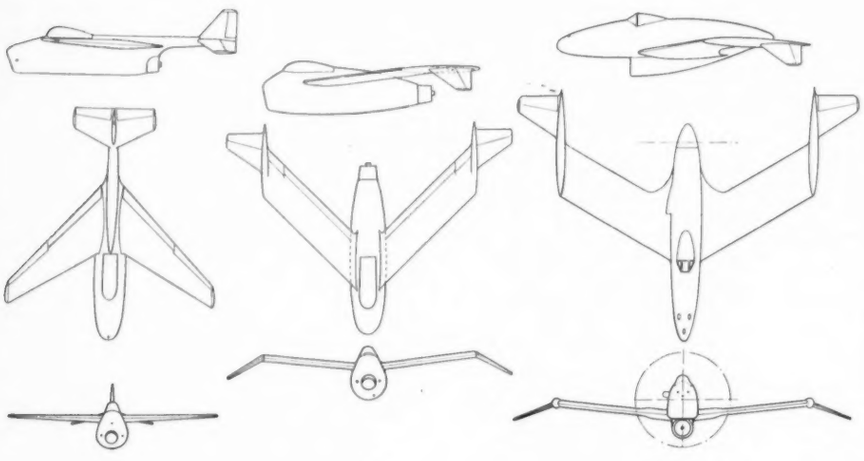


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Fig. 4 : Blohm & Voss P 209, project for Heinkel-Hirth He S-011 jet engine with static thrust of 2860 lbs (1300 kg).

Fig. 5 : Blohm & Voss P 212, project for the Heinkel-Hirth He S-011 jet engine with static thrust of 2860 lbs (1300 kg).

Fig. 6 : Blohm & Voss P 208, project for 2070 h.p. Daimler-Benz DB 603 L engine.

swept-forward wing ; fig. 4) and the *P 212* (tailless, with swept-back wing ; fig. 5).[2]

What is true for jet fighters—that swept wings reduce drag—must also apply to piston-engined fighters. Therefore, the last comparative type chosen is another Blohm & Voss project, the *P 208*, with a 2070 h.p. engine (fig. 6). A piston-engined fighter with comparable performance is presumably still not in existence, although very much more powerful engines, thin-bladed propellers, etc. are available. At any rate the design shows what the propeller-driven fighter would be capable of if properly developed.

The examples selected (Table) represent a fair cross-section of the flying equipment available to air forces today. As it will be many years before supersonic fighters predominate in the equipment of front-line units, the conclusions drawn from this comparison will be valid for a long time to come.

[2] The majority of the details and diagrams are from Blohm & Voss.

Comparison of Speeds

As may be seen from fig. 7, the speed of the " Fury I " and the P 208 piston-engined fighters is 125 to 155 m.p.h. (200 to 250 km/h) less than that of the P 209 and P 212 jet fighters, up to a height of roughly 23,000 ft. (7 km), the " Fury I " being even slower at high altitudes than the P 208. The difference in speed between the " Vampire 6 " and the P 208 falls off considerably at greater height, so that at 33,000 ft. it is only about 25 m.p.h. (40 km/h). This slight superiority is to a certain extent compensated by the P 208's greater climbing performance at this height (cf. fig. 8). The latter is therefore quite capable of competing successfully with the " Vampire 6 " at about 30,000 ft. (9 to 10 km).

High speed may sometimes be a handicap, however, as for example in operations against ground targets. The conventional fighter-bomber attack can never be made at the top speed of a jet fighter. Bomb sights for horizontal bombing are not provided in fighters. Therefore bombs must be dropped in a dive, the speed of which may not exceed a certain figure if the bombing is to be done from a low height with sufficient accuracy. Moreover, if the speed is too high the pilot may have difficulty in identifying his target and making full use of natural cover in very low flight. Similarly, certain reconnaissance tasks in the Army's field of operations require relatively slow flight.

It is of course possible to fly a fighter at reduced power and make full use of its reserve power only in an emergency. Its high top performance is not always essential to the successful completion of the actual operation. *There is a whole series of tasks and conditions for which even piston-engined fighters have greater speed than can be used.*

Comparison of Climbing Performance

The " Fury I " is designed for operation at medium altitudes and the P 208 for high altitudes. The rate of climb of these two piston-engined types is consequently greatly in excess of that of all other types under comparison up to a height of 20,000 ft. and 36,000 ft., respectively (6 and 11 km ; fig. 8).

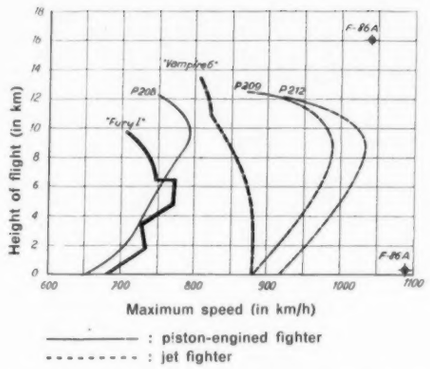

Fig. 7 : Comparison of maximum speeds for mean flying weight, with take-off and emergency output (water-methanol injection) or full thrust.

The jet fighters under comparison require a longer time to climb to a given *operational height* than the " Fury I ". A propeller-turbine engine (Westland " Wyvern ") would be even more advantageous.

Piston-engined fighters could still operate successfully against piston-engined bombers if they were not molested by jet fighters. This could best be ensured by the *combined* employment of piston-engined and jet fighters. Practical experience during the war showed that the piston-engined fighter can frequently escape attack by jet fighters, in spite of its greatly inferior speed. Air battles between fighters with very different speeds and radius of turn etc., are as a rule very lengthy, so that the jet fighter will frequently run out of fuel and be forced to break away. Thus the piston-engined fighter benefits from a technical weakness in the jet fighter.

In addition to its superior acceleration properties and shorter take-off run, the piston-engined fighter has the great advantage of good climbing performance at low heights. This is particularly valuable for operations from airfields closely surrounded by obstructions (e.g. small mountain airstrips) which cannot be used by jet fighters.

However it is not merely the rate of climb which counts. Equally important, from the tactical point of view, is the angle of climb. *Here again the piston-engined fighter scores, because it climbs at a steeper angle and thus covers a shorter distance in reaching a given height, a very useful quality in air combat.*[3] In some cases other than combat, however, the " long " climbing distance of the jet fighter may be an advantage.

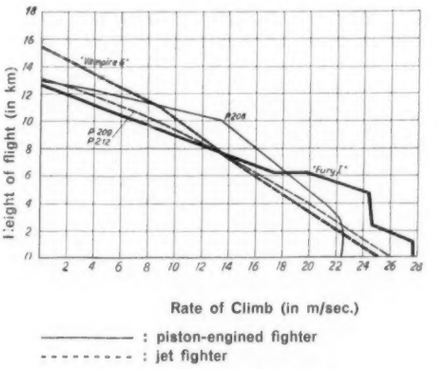

Fig. 8 : Comparison of climbing speeds for mean flying weight, with climb and combat output or full thrust.

Take-off Run and Operational Base

Piston-engined fighters are characterized by very short take-off runs. The P 208 would be airborne after only 1180 ft. (360 m) on grass [4] and the take-off run of the " Fury I " must be assumed to be even shorter. On the other hand jet fighters require considerably longer runs, i.e. 2,300 ft. (700 m) for the P 212 and P 209, or twice as long as for the P 208. Among the jet fighters not even the " Vampire 6 "—with a take-off run of only 1800 ft. (550 m)—can be classed as suitable for service at field landing grounds in the usual sense. *Natural* plains with take-off runways of 2,300 to 3,300 ft. (700 to 1000 m) in at least one direction, or preferably in two or three, with the necessary freedom from obstructions, are not frequently to be found. In Central Europe at any rate there are far more small natural take-off areas suitable for piston-engined fighters than large ones fit for use by jet fighters.

Owing to the fact that larger airfields are necessary, jet fighter units require a much deeper and broader deployment area. Such decentralisation is an advantage from the point of view of bombing risk, but a disadvantage from the point of view of the relatively small endurance of the jet fighter. Piston-engined fighters, on the other hand, can if necessary be deployed in a much smaller area, which facilitates concentration of forces and the rational employment of total resources. *The flexibility of deployment of jet fighter units is therefore much more restricted than that of piston-engined fighter units.* For example, topographical conditions may make it *essential* to station jet fighter units in dangerous concentrations at a small number of large airfields, when it does not even necessarily follow that this deployment area is particularly well-placed from the point of view of operational requirements.

For such reasons as these the average distance of operational bases from the front will generally be greater for jet than for piston-engined fighters. During World War II the fighter units' ground organisation could come close up to the front and follow the movements of the latter with little delay, but this will not be possible to the same extent when jet fighters come into operation *en masse*. Command and tactics are faced by new conditions where the distance of operational bases from the front—dictated by the take-off runs or size of airfield required —is of paramount importance, particularly for missions where the approach route must be short [5].

Since both jet and piston-engined fighters of the same size take roughly the same time to become airborne on being alerted, the superior speed of the former will not be of any advantage unless the distance to be covered is above a certain limit. The following example illustrates this argument :—

A squadron of 12 *piston-engined fighters* is stationed *12,4 miles (20 km)* from a vital bridge close to the front, with the task of protecting it from bombing. The speed of the squadron is 445 m.p.h. (720 km/h). Another squadron of 12 *jet fighters* is stationed 30 miles (approx. 50 km) from the same bridge, as there is no airfield big enough any nearer. Its speed is 615 m.p.h. (990 km/h). Both squadrons are on course for the bridge at the same height over their airstrips three minutes after receiving the alarm. As the height of approach is assumed to be low, the effect of differing rates of climb can be ignored.

In spite of the fact that the jet fighters are some 170 m.p.h. (270 km/h) faster, they will get to the target 1.4 minutes later than the piston-engined fighters, because of their longer approach route. Experience has shown that even such a slight delay may jeopardize the chances of success, particularly when the enemy operates from airfields very near the front or escapes radar detection by flying very low.

If the jets are to arrive at the bridge at the same time as the piston-engined fighters their airfield must not be further away than 16.8 miles (27 km). The vastly superior speed of the jets gives only 4.4 miles (7 km) play compared with the piston-engined fighters, so that here the high speed of the jets is of no appreciable advantage. If there is no suitable airfield for jet fighters within this radius, then the jets are *at a disadvantage as regards time* compared with the piston-engined fighters. Their operational value for this particular task is reduced, whereas that of the piston-engined aircraft is increased.

The take-off run of jet fighters could of course be shortened appreciably by using liquid or powder rockets to assist take-off (catapults need not be considered here, since they are not suitable for mass operations). But a powder rocket giving a thrust of 2,200 lbs (1000 kg) over 6 seconds contains about 75 lbs. (34 kg) of powder. And the 109.718 rocket accessory to the BMW 003 engine consumes 68 lbs. (31 kg) of fuel and nitric acid in the same time and for the same thrust. The daily consumption of powder or liquid fuels can thus be imagined. For other reasons, too, such as the extra strain on the supply system, rocket take-off aids are not always a practical proposition.

The far-reaching disadvantages of long take-off runs and the advantages of short runs all favour the piston-engined fighter.

Flying time and distance

The performance of modern piston-engined fighters in miles per gallon of fuel is far superior to that of jet fighters, particularly at low altitudes. At greater altitudes fuel consumption and range of jet fighters improve very noticeably (fig. 9 and 13). On the other hand the ratio shifts again in favour of the piston-engined fighter if *instead of comparing the absolute range, a specified combat time is taken and the range of both types is reduced by this amount.*

A comparison of the total endurances (fig. 10) shows the piston-engined fighter to be vastly superior. This applies particularly

[3] The advantage of the " short " climbing distance is shown by the Me 163 B rocket interceptor. It reached a height of 33,000 ft (10 km) in 2¼ to 3 minutes at an angle of climb of 45° or more, its speed being about 435 m.p.h. (700 km/h). In such conditions the enemy will almost always be taken completely by surprise. Tactically it is extremely valuable to be able to approach an adversary (e.g. a jet fighter flying with reduced power) *at a steep angle from below* or *to get away steeply upwards*, even if only temporarily. The very short total endurance of the Me 163 B is ignored here.

[4] On concrete runways the run is 10 to 15 % shorter.

[5] Take for example the " air siege " of Sebastopol in 1942. It was essential here to have the shortest possible approach route, not so much to save fuel as for tactical reasons. Only if the shortest possible time elapsed after receipt of the alarm could the enemy be engaged before he himself attacked. The short take-off run of the Me 109 enabled use to be made of a small airstrip very near the front. This gave the shortest approach time and thus assured success.

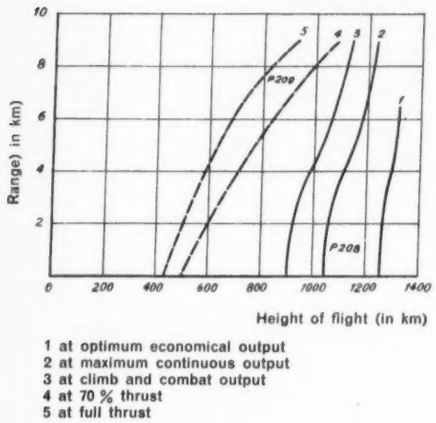

Fig. 9 : Range, including climbing distance, for the P 208 piston-engined fighter (1320 lbs = 600 kg fuel; ———) and P 209 high-speed jet fighter (2200 lbs = 1000 kg fuel; - - - - - - -).

to *flight at reduced power*, when the piston-engined fighter's endurance at lowest speed and performance with lowest fuel consumption can be increased by about one hour. For large-scale operations, when the time required for forming up is great, and for bad weather and blind flying missions, the endurance should be as great as possible. In any case it is essential to retain a certain fuel reserve as a safety margin. This reserve has a far greater effect on the radius of action of the jet than of the piston-engined fighter.

The total endurance of the jet fighter, however, again depends very largely on the height of flight and increases with the latter. If an altitude of 33,000 ft. (10 km) is taken, instead of 20,000 ft. (6 km), the difference would be greatly reduced. An increase in combat time and fuel reserve causes the difference to increase again. *By climbing to greater heights and/or reducing power the jet fighter can therefore considerably increase its endurance, but reduction in power must be at the expense of speed and range.* [6] For a jet fighter to fly slowly, however, increases its vulnerability to faster jet and piston-engined fighters. However economically they fly, jet fighters can never approach the endurance and performance of their piston-engined counterparts. [7]

Endurance is an extremely important factor from the tactical point of view. If the actual encounter with the enemy is delayed, for example by evasive action on his part, it will depend entirely upon the fighter's remaining endurance whether battle can ever be joined. Frequently a pilot may fail in his mission only because he runs out of fuel. This may also happen if the mission is dragged out unexpectedly because the radar system on the ground works too slowly or under particularly difficult conditions (e.g. enemy approaching at high altitudes).

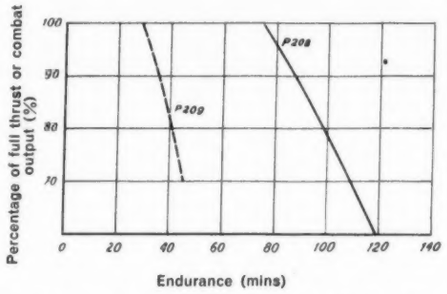

Fig. 10 : Endurance at 19,500 ft. (6000 m)—after completion of climb and without reserve for combat time—for the P 208 piston-engined fighter (1320 lbs = 600 kg fuel; ———) and P 209 jet fighter (2200 lbs = 1000 kg fuel; - - - - - -).

[6] When output is reduced in the piston-engined fighter the speed sinks roughly in proportion to the cube root of the reduction in power; if thrust is reduced in the jet fighter the loss in speed is roughly proportional to the square root, i.e. considerably greater.

[7] As regards total endurance, the "Vampire 6" shows no advance on the 1944 Me 262. If the possibility of carrying *more* fuel in auxiliary tanks is ignored, endurance of both types is equally inadequate. Here it may be mentioned that the Tank Ta 152 H piston-engined fighter, with auxiliary tanks, had an endurance of 220 minutes at maximum continuous output.

From the point of view of tactical endurance, which has a decisive effect on the operational value of a fighter, piston-engined fighters must be conceded to be in the lead.

An operational comparison

Fig 11 compares the operational value of piston-engined and jet fighters, given return to take-off base and certain other factors (combat time, engine output). Assuming that the approaching units maintain the course reported when the fighters take off, the *earliest possible points* at which fighters and bombers can meet, with fully efficient fighter control, can be calculated. The fighters will be assumed to take off as soon as the bombers, approaching at 435 m.p.h. (700 km/h), have reached a line 220 miles (350 km) from the take-off base.

The point at which the faster jet fighter will encounter the enemy will, it is true, be somewhat further forward, but the gain will be small and will reach some 30 miles (50 km) only on the flanks. The *conditional defensive range* for the jet fighter is about ± 175 miles (280 km), that of the piston-engined fighter about ± 310 miles (500 km). It is called "conditional" because the bomber (as shown in the left half of the fig. for the jet fighter) can fly round the interception zone of the fighter and subsequently attack a target inside this zone without being intercepted. The jet fighter is thus out-manœuvred and it cannot reach its target because of lack of fuel. Bombers which fly outside the range of the fighters are inaccessible if the fighter is to return to its base.

The factors on which this description is based are optimistic. The return flight for example cannot always be made at economical cruising power since danger to the fighter does not as a rule cease suddenly when the battle is broken off. For reasons of safety a fuel reserve must be provided, in case the fighter becomes involved in unexpected air combats on the way home. The combat time of 10 minutes represents a minimum, since as a rule the pilot gives full throttle from the moment he sights the enemy.

The American F-86A "Sabre" jet fighter is reported to have a radius of action (excluding combat time) of 540 miles (850 km) and a range of 1,250 miles (2,000 km) without auxiliary tanks or 2,310 miles (3,700 km) with auxiliary tanks (in both cases without combat time). These figures throw some doubt on the validity of the above comparisons of range and operational depth. It remains true, however, that there will always be a striking difference in fuel consumption between piston-engined and

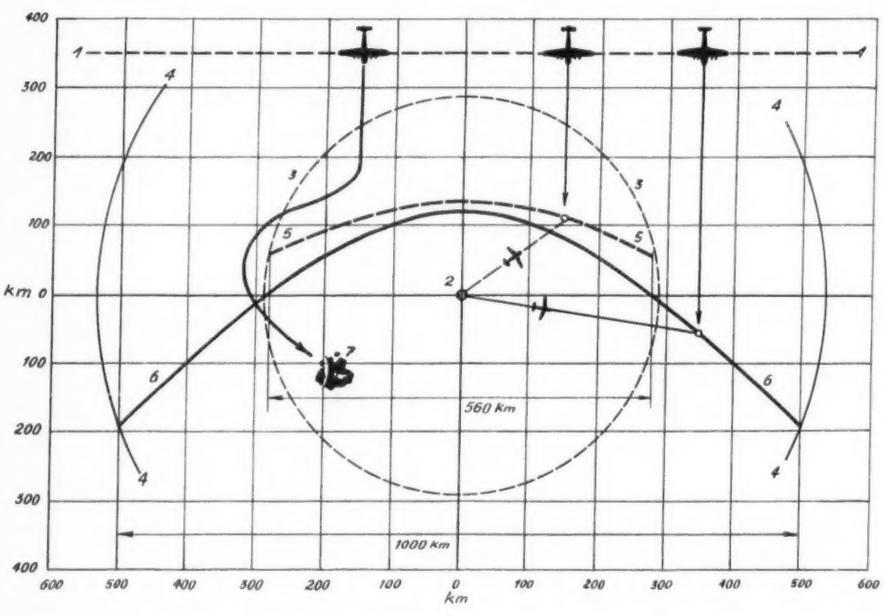

Fig. 11 : Operational comparison between jet fighters and piston-engined fighters, assuming fighters' return to take-off base.

——— : piston-engined fighter (P 208)
- - - - - - - - - : jet fighter (P 209)

Given: Bombers approach at 435 m.p.h. (700 km/h); fighters take off when bombers reach line (1) 220 miles (350 km.) from take-off base (2); radius of action (3 and 4) equals half the range (Fig. 9) minus 10 minutes combat time. Approach of piston-engined fighters at maximum continuous output, air combat at combat output with water-methanol injection, and return at optimum economical output; approach and air combat of the jet fighters at full thrust, return at 70 % of full thrust.

Results : Lines of earliest possible encounters (5 and 6); conditional defensive range of the piston-engined fighters approx. ± 310 miles (500 km); conditional defensive range of jet fighters approx. ± 174 miles (280 km) danger of "out-flying" the jet fighters, i. e. undisturbed bombing of a target (7).

jet fighters whenever two aircraft types of a comparable stage of development are compared. The F-86 is a " forced " development, in which particular emphasis has been laid on range. A piston-engined fighter of a comparable stage of development does not exist at present. If a piston-engined fighter were similarly designed to give maximum possible range, it would certainly surpass the F-86 in range and radius of action. In the second case the advantage of the piston engined fighter becomes more marked as the fuel allowances that must be made for combat and safety margin increase, it being remembered that the greater the radius of action the greater the safety margin required.

The higher the speed of the bombers, the earlier the fighters must start out and the longer will be the distance covered before the encounter. This is of advantage to the jet fighter in that it can make use of its superior speed. On the other hand the bombers gain greater freedom to indulge in diversionary and evasive tactics of all kinds so as to outfly the fighters. These tactics are far less effective against piston-engined fighters, on account of the latters' greater endurance, than against the jet fighter which is limited in this respect. A noteworthy improvement in defensive range can be obtained if the fighters do not return to their take-off base. This would have a relatively greater effect on the radius of action of the jet fighter than of the piston-engined aircraft.

Acceleration and deceleration behaviour.

As a rule the jet fighter takes much longer than the piston-engined fighter to accelerate (at reduced power) from the same initial speed to its maximum speed, which is always much higher than the latter's. This also applies to acceleration after take-off. It follows then that the jet fighter will be at a disadvantage in relation to enemy jet fighters for a longer period after take-off than the piston-engined fighter in relation to other piston-engined aircraft during the same flight phase.

Nevertheless, the distance covered during acceleration—from the same initial speed up to the same final speed—is shorter for the jet fighter. With an initial speed of 310 m.p.h. (500 km/h) the P 209 jet fighter would reach a final speed of 470 m.p.h. (755 km/h) after flying about 12½ miles (20 km), but the P 208 piston-engined fighter would have flown about double the distance for the same increase in speed. This particular factor favours the jet fighter after take-off only if its sole opponents are piston-engined fighters. *It reaches the maximum speed of the piston-engined fighter in a much shorter distance and time.* The reasons for this are the considerably reduced drag at this speed and the smaller mass which has to be accelerated in the jet fighter.

The jet fighter covers a much longer distance than the piston-engined fighter in slowing down from its higher maximum speed. Even starting from the same speed the piston-engined fighter can lose speed more rapidly because of its propeller and its greater total drag. Air brakes, such as those fitted in the " Vampire ", are therefore particularly useful in the jet fighter and open fresh tactical possibilities. A reversible propeller serving as a " tactical brake " would, however, once more increase the difference between piston-engined and jet fighters.

In air combat it is important to be able to lose speed. The more rapidly this can be done the better it is for attack and defence. The tactical value of deceleration is even greater in operations at very low altitudes, particularly when there is a big difference in speed between the two opponents. But even when the parties are well-matched it is important.

Armament and armour-plating

With the exception of the " Fury " (with tractor propeller), all the types considered here can feature centrally-mounted, unsynchronized guns (i.e. the most efficient armament). In the P 208 the empty ammunition has to be collected in a container, as otherwise it falls into the propeller disc. This means a reduction in the amount of ammunition which can be carried. As the writer does not consider that defensive armament of fighters (i.e. rearward-firing guns) is necessary, it is not dealt with here.

The armour-plating of piston-engined fighters (both front and rear), in particular that of the " Fury ", is generally more complicated than that of a jet fighter. In the latter the intake openings are vulnerable, unless, as in the " Vampire ", there is a diversion of the flow, which of course is made at the expense of power ; in any case the jet opening is vulnerable. The protected frontal area of the P 209 is only about 10% greater than that of the piston-engined P 208, as is shown in fig. 12. The P 208 has a fully screened radiator installation (except of course for the air intake scoop).

Protection for the fuel is more easily arranged in the piston-engined fighter because of the smaller quantity involved. In all fighters the fuel for a certain length of flight shortly after take-off could be left unprotected. This would not give the jet fighter any appreciable advantage, since even after it has consumed the unprotected fuel it still has a greater quantity of fuel to carry than the piston-engined fighter. Here the advantage is clearly to the latter and above all to the propeller-turbine powered fighter, which in addition generally uses kerosene instead of petrol.

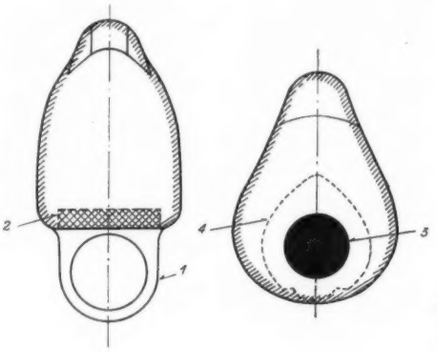

Fig. 12 : Armour-plating for P 208 piston-engined fighter (left; 1,37 m²) and P 209 high-speed jet fighter (right; 1.50 m²); cooling air intake (1) to the radiator (2) and intake opening (3) to the turbojet (4) are unprotected.

Construction costs

The only appreciable differences are in the power plants. The structural weight of the reciprocating engine considerably exceeds that of a jet unit of the same class. This is due in part to the former's various accessory equipment, such as supercharger, ignition system, propeller, etc. Consequently the production and maintenance of high-performance piston engines is, as a rule, costly. The simple structure of the jet unit means reduced expenditure of labour and materials. The life and reliability of jet units will in future undoubtedly be much greater than those of piston engines. The advantage here lies unmistakably with the jet fighter.

Comparison of Fuel Requirements

At low altitudes the jet fighter requires roughly four times as much fuel as the piston-engined fighter, and at 29,500 ft. (9 km) it still consumes twice as much. On an average consumption can be taken to be 2½ times as great, since both *consumption per kilometre* (shown in fig. 13) *and hourly consumption*, are less favourable in the jet fighters. [8]

For any nation whose fuel resources are limited the question of consumption plays an important, if not a vital, rôle. If therefore it is assumed that the present tendency of the bigger air forces is continued and that one day the majority of units—with the possible exception of transport and naval aircraft—will be equipped entirely with jet aircraft, consumption of 2½ times as much fuel must be allowed for as would be necessary for a similar number of piston-engined aircraft. In the event of hostilities such tremendous fuel supplies would be required that even countries who have rich oil resources would be confronted by the greatest difficulties. Supplies remain a problem even if lower quality fuels are used for jet engines. When the sources of supply lie in part or wholly outside the country, as for example

[8] Consumption in the propeller turbine fighter is about 50% greater than in the piston-engined fighter.

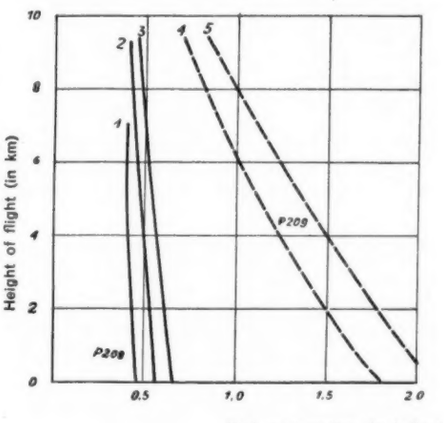

Fig. 13 : Fuel consumption per km flown in the P 208 piston-engined fighter (————) and P 209 jet fighter (- - - - - -) plotted against throttle position and altitude of flight.

in the case of Great Britain, they represent a nerve centre whose sensitiveness increases with their distance from the theatres of operations. Storage space, too, must be increased very considerably and is therefore more vulnerable to attack.

A future trial of strength will depend on fuel supplies to a far greater extent than did either of the two World Wars. A war lasting a number of years with thousands of jet aircraft operating daily is no longer conceivable. *Its duration will be limited not only by aircraft production but by fuel supplies. This cannot but affect the nature of operations and play a vital part in determining whether available weapons will be used or not.*

The combined use of jet and piston-engined fighters increases the operational value of the latter. If in the event of war fuel supplies should diminish and it be no longer possible to maintain the maximum density of operations by jet fighters, then the additional employment of efficient, more economical piston-engined fighters would be more effective than the exclusive but constantly dwindling use of jet fighter units, with its inevitable undermining of morale. The density of operations could thus be largely maintained and the fuel available would last much longer.

Conclusions

The piston-engined (and propeller-turbine) fighter has been found to have advantages from the point of view of rate and angle of climb, take-off run, range and endurance, " conditional " defensive range, protection of fuel tanks and fuel consumption. On the other hand, jet fighters have the following advantages :—greater maximum speed, better facilities for the installation of offensive armament, simplified installation of armour-plate (except for the fuel) and lower production and maintenance costs.

The greatest disadvantage of the piston-engined and propeller-turbine fighter is that it is impossible at the moment to give it a maximum speed comparable to that of the jet fighter. The decisive disadvantage of the latter is their longer take-off run and greatly increased fuel consumption.

When the manifold tasks of the air force in support of the Army are considered (tasks which are carried out at low altitudes), such as day and night ground attack missions, fighter-bomber attacks, reconnaissance, artillery spotting, low-level flying over long distances, not to mention tactical protection of special targets (particularly near the front), bad weather fighter operations and (for two-seaters) night fighting, as well as missions in collaboration with the Navy, — the advantages of piston-engined fighters are obvious. For the time being good use can still be made of this kind of aircraft. What of the future ?

For the present, aerial warfare would still take place at subsonic speeds. The next phase will see fighters operating in the supersonic range, but—on the whole—bombers flying at sub-sonic speeds, and it will only be in the third phase that both fighters and bombers will operate primarily in the supersonic range. Will there be any room then for a piston-engined fighter with a speed of only 500 to 560 m.p.h. (800-900 km/h) ?

This is equivalent to asking whether, after the appearance of tanks, the " slow " infantry disappeared.—There will be jobs enough for the piston-engined fighter for a long time to come. The existence of jet fighters will not alter this fact any more than modern long-range missiles have yet made bombers superfluous. Piston-engined fighters might even be indispensable against an enemy who himself was operating large numbers of piston-engined fighters. Marked differences in the flying qualities or performance (manoeuvrability, turning ability etc.), such as exist between piston-engined and jet fighters, make air fighting more difficult and frequently ruin the " superior " aircraft's chances of success. [9]

The tactical possibilities of the piston-engined fighter are by no means negligible, provided it is employed efficiently and full use is made of its advantages in situations where jet fighters have obvious weaknesses. The piston-engined fighter's chances of success against jet fighters are small, but against other air and ground targets they are very satisfactory, even in the long run. It is not denied that the climbing performance of the piston-engined fighters mentioned here is inferior to that of the latest high-performance jet fighters and that the future potentialities of the jet fighter are much greater. For the moment, however, this fact is to the detriment of piston-engined fighters only in some, but by no means all, circumstances.

Finally, let it not be forgotten that *quantity* plays a large part in modern warfare. It *may* triumph over quality, as was seen in the fighting on the Russo-German front. To counter quantity with quality is possible only within certain limits.

Whether the death sentence is to be pronounced on the piston-engined fighter after all will ultimately be decided by the strategists and tacticians, whose opinion will be influenced by their own conception of the future development and tasks of the fighter arm. The writer, however, is of the opinion that piston-engined fighters cannot and should not be dispensed with for a long time to come. Far-sighted planning should provide for a propeller-driven fighter (reciprocating engine or propeller-turbine) with maximum power at relatively low altitude (e.g. 10,000 ft. or 3,000 m.) and a further type with maximum power at high altitude. In both cases climbing performance, manoeuvrability and range must be outstanding.

[9] Modern weapons can be used only for a relatively small number of different purposes. For example *the Me 262 should have been used only as a fighter and exclusively against bombers.* Here it would have been extremely successful, as its qualities were not fully suited for combat with piston-engined fighters. Allied piston-engined fighters should have been opposed by similar German fighters. If, to make a comparison, Germany had had no piston-engined fighters and had also not had sufficient suitable jet fighters, Allied piston-engined fighters would have been able to operate almost undisturbed, in spite of their inferiority to the Me 262 !

New Methods of De-Icing for Wings and Tailplanes

Fluid de-icing systems for propellers are well-known but very little has hitherto been published on the application of such systems to wings and tailplanes, despite the fact that a number of medium-sized British transport and military aircraft, such as the Vickers " Viking " and " Valetta ", Bristol " Freighter ", Avro " Shackleton " and " Tudor " and Handley Page " Hermes ", have already been fitted with TKS fluid de-icing equipment, not to mention several smaller types such as the De Havilland " Dove ".

We have before us a British European Airways report on de-icing trials carried out early this year by a Vickers " Viking " (G-AIJE). This report is of two-fold interest. On the one hand it shows that critical icing conditions are difficult to find when they are being specifically sought. On the other, it was proved that it is not necessary to use such large quantities of de-icing fluid (TKS R.328) as was hitherto thought. A new system of distributing the fluid recently developed by TKS (Aircraft De-icing) Ltd.,[1] has been found to be extremely economical.

[1] Owned by 1) Messrs. Tecalemit, Ltd., (lubrication and de-icing pumps)
2) The Kilfrost Manufacturing Co., Ltd. (de-icing fluid)
3) Messrs. Sheepbridge Stokes, Ltd. (powdered metallurgy).

De-icing Trials

Between 3rd January and 7th March 1950, the G-AIJE, with *Captain W. Mason* and a crew of seven on board, made 27 flights over the North Sea, Scotland, Norway, North Germany and France, which lasted altogether over a hundred hours. During approximately 54 hours ice was encountered, samples were taken, and the behaviour of the ice on the stabilizer leading edge observed and photographed.

Here it should be mentioned that since the publication of NACA Technical Note *TN 1885* the intensity of icing conditions

has been indicated by the following three parameters :—

1. Water content of cloud flown through (in *Grams/cu.m.*).
2. Size of droplets (in *microns*, i.e. millionths of a metre).
3. Ambient temperature (in *degrees centigrade*).

At a given ambient temperature water content and size of droplets are interdependent within certain limits, i.e. the greater the water content the smaller the droplets. Moreover water content decreases rapidly as temperature falls. On the other hand at lower temperatures greater heat is required to warm up the aerofoil leading edges (thermal de-icing) or a higher concentration of de-icing fluid in the ice deposited to prevent bonding (fluid de-icing). The atmospheric conditions most frequently to be expected to produce *continuous* icing are indicated in fig. 1 which also shows some of the measurements made during the " Viking " flights.

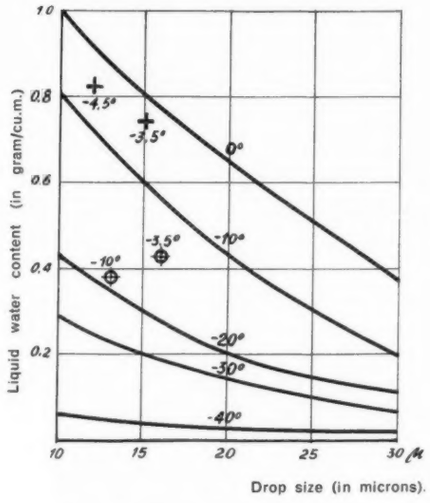

Fig. 1. Atmospheric conditions for continuous maximum icing (according to NACA TN 1885) showing values obtained during fluid de-icing trials by the G-AIJE (January to March 1950 ; cf. figs. 6 & 7).

Fig. 2. Instrument for measuring liquid water content and droplet size, as recommended by I. Langmuir and K. Blodgett of the General Electric Co. of America.

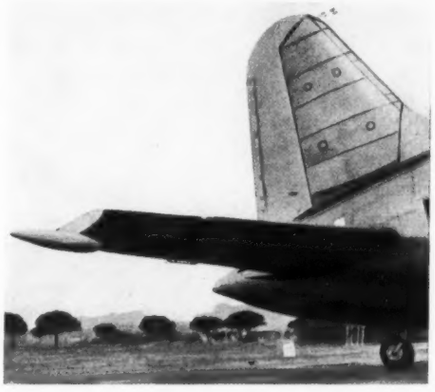

Fig. 3. Tailplane of the Vickers " Viking " G-AIJE. The inboard portion shows a test section for ice measurements with the standard double insert distributor. The outboard portion is fitted with " Porosint " panels. The rate of flow of the de-icing fluid through both test sections was systematically varied.

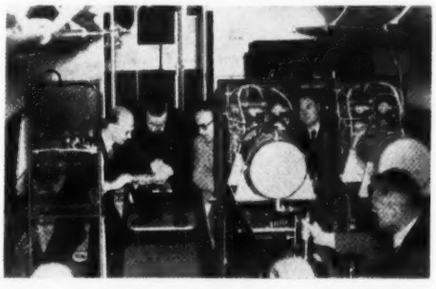

Fig. 4. Inside the test aircraft. The two test sections on each half of the tailplane are fed with R. 328 protective fluid from separate tanks and by means of separate electrically driven pumps. Amperage and voltage of the pumps, and flow of fluid are also recorded.

The instrument used to measure the cloud water content and drop size is shown in fig. 2. It consists of three co-axial cylinders of 1/8" dia., 1" dia., and 2" dia., (3.2 mm, 25.4 mm and 50.8 mm) respectively, attached to the end of a 3 ft. (1 m.) long tube. Each cylinder is projected into the airstream for two minutes and rotated by hand. After samples have been taken in this way, each cylinder is placed in a separate airtight container. Atmospheric water content and droplet size can be determined from the difference in weight of the containers. The values obtained, however, are always slightly less severe than actual conditions on wings and tailplanes, because some of the water is blown away. Ambient temperature was measured by means of an electrical thermometer.

The " Viking's " de-icing trials also proved that continuous conditions are more severe than acute icing. Aircraft are often obliged to fly for some time in ice-forming stratus cloud layers, whereas cumulo-nimbus clouds are never very extensive and are generally avoided. The trials also showed that warm fronts and occlusions seldom produce danger of icing. In particular, freezing rain (in warm fronts) proved to be harmless. Altogether it was difficult to find icing conditions lasting any length of time. Meteorological forecasts are still very unreliable from this point of view ; as a rule more severe icing conditions are forecast than actually occur, though sometimes the reverse is the case.

The arrangement of the test equipment is shown in figs. 3 and 4. As the tailplane was easier to observe than the wing leading edge, the test sections were confined to the centre of the port and starboard tailplanes. Each was fitted with a standard double TKS strip insert distributor (fig. 5 left) and a new TKS " Porosint " panel distributor (fig. 5 right). The de-icing fluid was fed to the test sections from two separate tanks each of 7.7 gallons (35 lit.) capacity by means of electrically driven pumps (with several outlets). Rate of flow was measured by

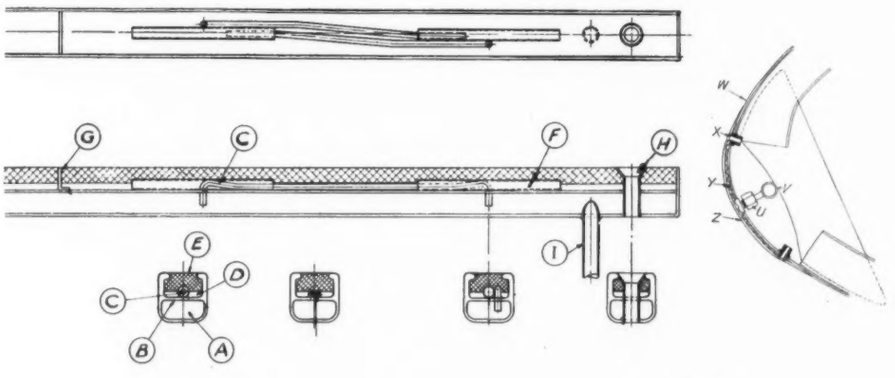

Fig. 5. **Left : the earlier TKS distribution system :** — The R 328 protective fluid flows from two cold-drawn Monel channels above and below the stagnation line, over the leading edge of the aerofoils. The fluid is fed in at point **(I)**. It is then passed along lower feed channel **(A)** over the span and thence through accurately calibrated tubes **(C)** (with cover tubes **F)** into upper channel **D**. The latter is separated from the lower channel by a web **B**, covered with a distributor strip **E** (of porous Monel) and divided along its length by dams **G**. Screws **H** hold the channels in place. In this system the individual calibration of tubes **C**, of both bore and length (2 to 3 ins. = 5 to 8 cm), is very important if accurate supply of de-icing fluid to all sectors is to be maintained in spite of variations in hydrostatic pressure (e.g. in the fin or resulting from the dihedral angle). **The picture on the right shows the new distributor system.** A " Porosint " sheet **Z** 0.05 in. thick (1.5 mm) with corrugated backing sheet **Y** is attached to the leading edge cover **W** by means of two rows of rivets **X**. The de-icing fluid is fed through a tube **V** running parallel to the span, by means of calibrated branch tubes **U**. A special paste is applied between the " Porosint " panel (phosphor bronze) and the duralumin skin, to prevent contact between these two dissimilar metals.

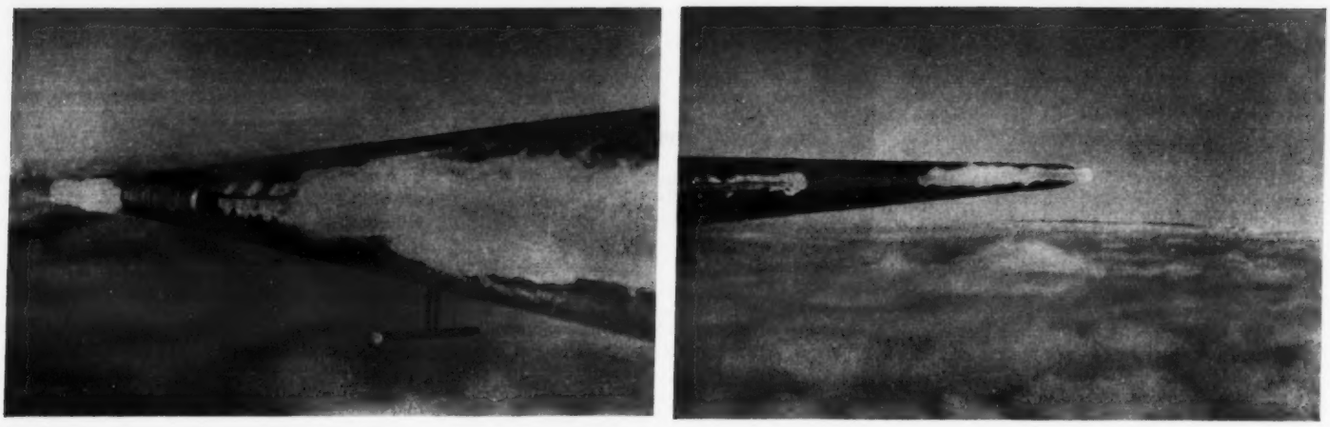

Fig. 6 & 7. The photograph on the left (starboard tailplane) was taken after flying about 20 minutes in ice-forming stratus cloud at a height of 3,500 ft. (approximately 1000 m.) and at a temperature of —10° C. The water content of the cloud was 0.38 gm./cu. m. and the droplet size 13 microns. The photograph on the right (port tailplane) was taken at the same height, but after the " Viking " had encountered a water content of 0.43 gm/cu. m. and droplets of 16 microns at a temperature of —3.5° C. In both cases the " Porosint " panels, operating on 1/3 pint/hr/sq. ft. (2 lit/hr/m²) frontal area, show no ice accretion. The double strip insert distributors on the other hand, operating on 2/3 pint/hr./sq. ft. (4 lit/hr/m²), did not entirely prevent accretion. Ice formed to a thickness of over 2 ins. (approx. 6 cm) on the unprotected areas on either side of the test sections.

means of calibrated bores and by-pass cocks. Fluid pressure, as well as the amperage and voltage of the pump motors were also measured.

The TKS De-Icing System

The two distributor systems illustrated in fig. 5 spread over the wing and tailplane leading edges a thin protective film of R.238, which prevents the adhesion of ice to the aircraft. As a rule the system is set in operation (by hand, or automatically by means of an ice detector) as soon as icing conditions occur, i.e. before effective ice accretion. However, even if the feed pumps are switched on later the ice already deposited can still be removed, because the fluid exuding as a very fine film from the pores of the distributor strips or panels destroys the bond of the ice, and the air stream lifts off the ice crust and blows it away.

The special protective fluid, TKS R.238, whose composition is obviously not only patented but kept secret, has four important qualities, viz :— sufficient viscosity to form a film (1), high ice melting properties (2), solubility in water (3), without however being instantaneously miscible on contact with water droplets (4). As it is only necessary to form a film and not to mix the whole of the water encountered within the catchment area with sufficient de-icing fluid to depress its freezing point to below the ambient temperature, the system is very economical. For example, at —10° C the percentage of TKS R.328 required to prevent the water from freezing is 25 %. However, as little as 2 % is sufficient to reduce the strength of the bond of ice already formed to approximately 1.4 lbs/sq.in. (0.1 kg/cm²).

Needless to say the protective film must be spread over a sufficiently large area of the leading edge. This is done by means of either the strip distributors, which enable the fluid to run upwards and downwards over the leading edge, or of the new " Porosint " panels, when it is sufficient to keep the surface of the panel wet. " Porosint " is a sintered phospher bronze, which, although smooth-surfaced, contains millions of pores through which the de-icing fluid passes (in fact it is virtually sucked through by capillary action). It is fitted in thin sheet form over the stagnation line of the wing or tailplane.

Super-cooled water striking the leading edges immediately *starts* turning to ice, but there is a definite time lag before it becomes entirely frozen. When there is a protective film, sufficient R.238 is absorbed during this time to keep the ice at the interface soft and prevent it from bonding. Only the remainder of the water freezing later turns to hard ice.

Results

The trials showed that a *flow rate of* $^1/_3$ *pint/sq.ft./hour (2 lit/m²/h) frontal area* (measured at the point where the aerofoil is thickest) is quite sufficient, even in very severe continuous icing conditions (down to —11° C), to form a film and prevent bonding when " *Porosint* " *panels* are used, and that for the older distributor system (double strips of porous Monel) double this quantity is ample (figs. 6 and 7). Hitherto appreciably higher flow rates were thought to be necessary in both cases.

A four-seater touring aircraft with a wing area of 183 sq.ft (17 m²) and a wing frontal area of 10 per cent, would therefore require no more than 6 pints (3.4 lit.) of de-icing fluid for the wings and about the same quantity for the tail unit and propeller for one hour's flight in icing conditions, i.e. a total of 12 pints (6.8 lit.), when " Porosint " distributors are used.

The new TKS system is therefore proved to be particularly suited for the all-weather protection of smaller aircraft. Rubber de-icers have their well-known disadvantages —from the point of view of both maintenance and drag (in high-speed flight)—and moreover cannot be used on slots. Thermal de-icing systems will be limited to jet aircraft of all sizes (direct supply of hot air from the compressor) on the one hand, and to very large aircraft (heaters, secondary air conduits) on the other. The TKS system has already been introduced in the De Havilland " Dove ", Handley Page " Marathon " and Short " Sealand " (though still with strip distributors and high rates of flow). Is it perhaps not time to try it out in small private aircraft ?

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* *

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BREGUET 89 "Mercure"

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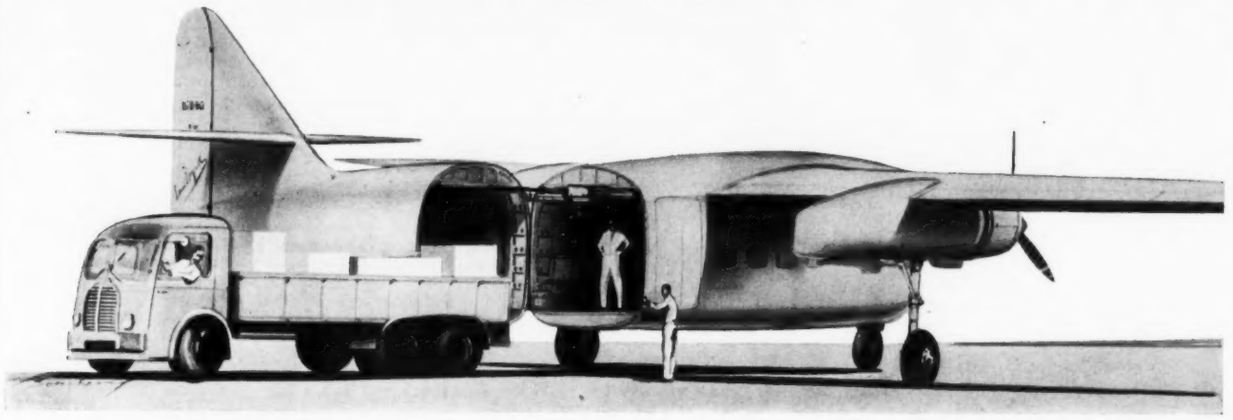

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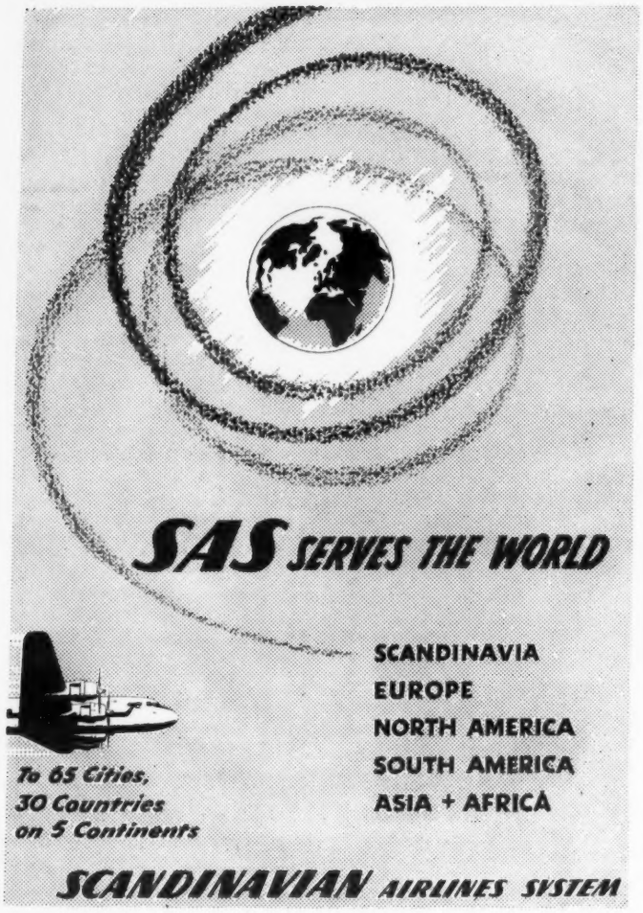

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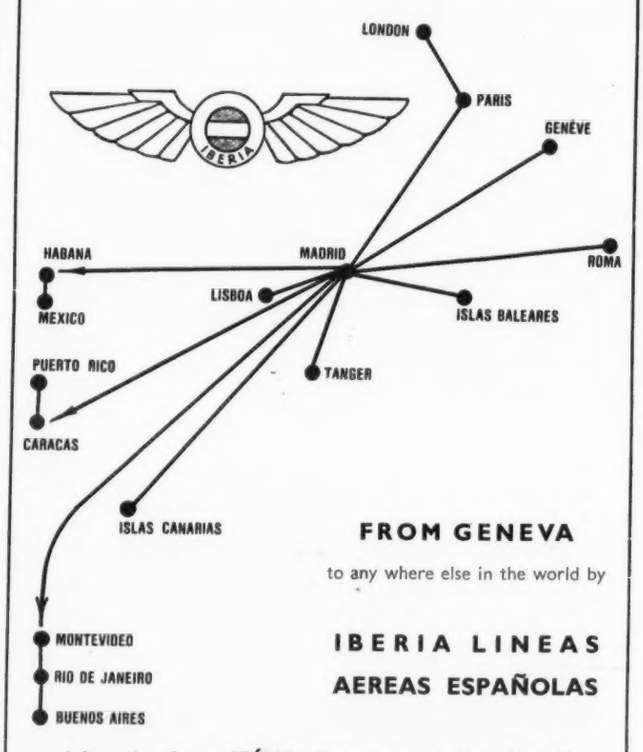

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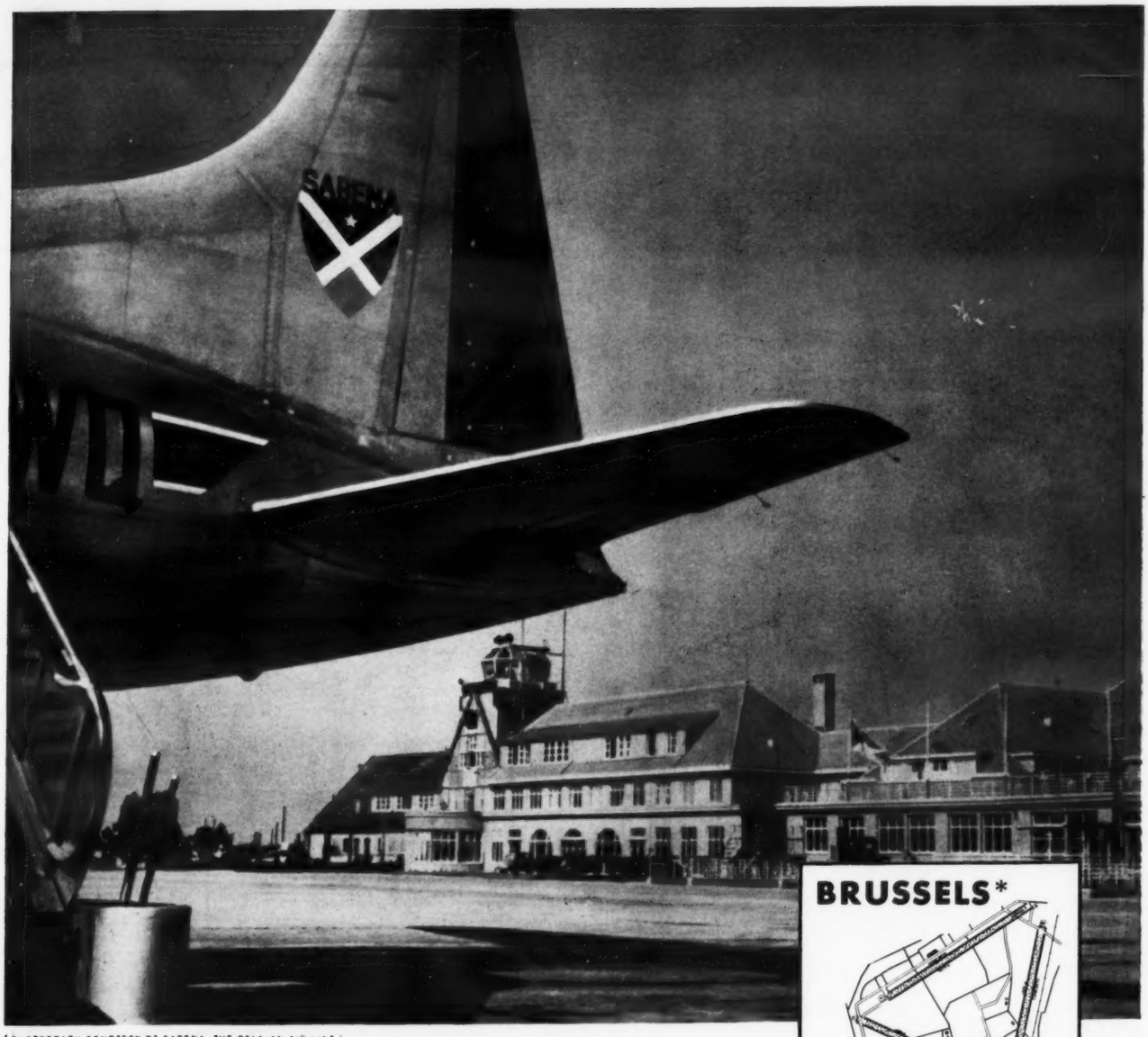

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